

INTERNATIONAL INSTITUTE OF AGRICULTURE
BUREAU OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

INTERNATIONAL REVIEW OF THE SCIENCE
AND PRACTICE OF AGRICULTURE

MONTHLY BULLETIN
OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

16 The Nutritive Value of Yeast, Polished Rice and White Bread as Determined by Experiments on Man. — FUNK, CASIMIR, LYLE W. G. and MC CASKEY, DONALD, in cooperation with CASPE, JOSEPH and POEHLER, JOSEPH, in *The Journal of Biological Chemistry*, Vol. XXVII, No. 1, pp. 173-194, Bibliography of 23 publications, Baltimore, Md., 1916.

Concerning the problem of a protein minimum, there are two distinct theories: ABDERHALDEN and his school claim that, as the composition of the body, and especially of the blood proteins, is so different from food proteins, the best protein minimum can be obtained by feeding proteins of the same species; on the contrary, HINDHEDE was able to show that, when using potatoes as practically the only food, 1 gm. of the absorbed potato nitrogen is equivalent to 1 gm. of body nitrogen. One cause of discrepancy of opinion on this question is that the importance of vitamins in metabolism has been overlooked in most recent experiments. There must be a fixed ratio between the vitamin content and the carbohydrate: if this ratio is destroyed, disordered nutrition of the tissue cell occurs (1).

Considering that heretofore the vitamins in foods have been disregarded in all nutrition experiments on man, the writers have performed on four normal men the experiments here described, in order to determine primarily the food value of a vitamin-free diet as compared with one containing vitamins. The results are summarized as follows:—

Yeast cannot very well be recommended as a sole protein source, as a large part of the yeast nitrogen apparently has no food value. It is badly assimilated and occasions a rise of uric acid figures in the blood. The

(1) In a recent paper of ABDERHALDEN, FODOR and RÖSE (*Archiv. gesammte Physiologie* Vol. CLX, p. 511, 1915) we find a comparative study of the food value of potatoes as compared with whole bread and white bread. The protein minimum was lowest in the case of potatoes (4.5 gm. nitrogen), higher with whole meal bread (7.0 gm. nitrogen), and still higher with white bread (9 gm. nitrogen), a possible reason being that the white bread was deficient in vitamins.

amount of nitrogen which would be fully adequate in the form of potatoes was proved to be insufficient with yeast. This also applies to the experiments with white bread and white rice. The writers were unable to get a positive nitrogen balance by the addition of vitamin.

In this field of nutrition research the authors' studies have by no means enabled them to pronounce a verdict that yeast possesses no value in dietetics.

Problems of personal idiosyncrasy as to the taste of foods, methods of administration suitable for the particular individual, questions of amino acid synthesis after the yeast protein and purine bases have entered the organism, are all complex factors which must be taken into consideration.

617 - The Digestion of Aleurone Cells Incorporated in 85 % Bread; Experiment Made in France. — LAPICQUE, L. and LEGENDRE, A., in *Comptes rendus des Séances de la Société de Biologie*, Vol. LXXXI, No. 5, pp. 217-220. Paris, March 9, 1918.

The envelope which encloses the wheat seed, the fragments of which more or less mixed with flour form the bran, contains on its inner surface the layer of aleurone cells. The authors' experiments confirm the fact, shown first by POGGIALE, then by AIMÉ GIRARD that the eminently digestible nutritive contents of these cells are protected from the action of the digestive ferments by the cellulose walls. The authors found aleurone cells in the faeces of men and dogs after the ingestion of wheat which had been roughly ground, chopped, or rolled after having been softened by soaking. The authors believe this fact should be extended to certain herbivorous animals as it was also observed in the guinea-pig and rabbit.

This resistance to digestive ferments is, however, clearly connected with the integrity of the walls. Baking does not affect the result, but, nevertheless, by rupturing the walls mechanically it is possible to render the nutritive substances accessible to the action of the digestive juices. In bran, the first milling which does not pass a No. 70 sieve, the walls of the layer of aleurone cells are intact, and the aleurone thus resists baking and digestion. If, however, the bran is re-milled so that most of it passes through a No. 10 sieve, the walls of the aleurone cells retained by a No. 200 sieve are still intact, but nearly all of these break during baking, and, after digestion only the empty walls are found in the faeces, the contents having been digested, as the authors proved experimentally. It is for this reason that in bread made with 85 % flour, the bran of which is mixed with fine flour and re-milled (as decreed in France at the present time) without any systematic preparation, the greater part of the aleurone cells is digested thus increasing the total food value of the bread by 1 to 2 %.

618 - Physiological and Pharmacological Studies on Coal Tar Colours. Experiment with Fat-Soluble Dyes. — SALANT, WILLIAM and BENCIS, ROBERT (Pharmacologist, Laboratory of the Bureau of Chemistry, U. S. Department of Agriculture, Washington) in *The Journal of Biological Chemistry*, Vol. XXVII, No. 2, pp. 403-427, Bibliography of 20 publications. Baltimore, Md., 1916.

Although synthetic dyes have played an important part in the study of biology and medicine, the behaviour of many of these compounds in the body is still imperfectly understood and the action of some of them:

entirely unknown. Owing to their extensive employment in numerous industries, and especially in the preparation of foods, this lack of satisfactory information frequently proved to be a matter of serious import as questions regarding their effect on health were often raised, but no definite answer could be given in the present state of our knowledge.

The recognition of the need of a more intimate acquaintance with the reactions produced in the body by these compounds formed the starting point of these investigations.

The present report embraces the results of experiments with fat-soluble dyes. The following compounds were employed, the commercial names most commonly used and their numbers in SCHULTZ's tables are given at the right: —

benzeneazo- β -naphthyl- amine	Yellow A. B. **	Benzeneazodimethylaniline Butter Yellow 32*
benzeneazo- β -naphthyl- amine	Yellow O. B. **	Benzeneazophenol Oil Yellow
benzeneazobenzeneazo — β -naphthol	Sudan III 323*	Benzeneazoresorcinol . . . Sudan G. 351*
benzeneazo- β -naphthol	Sudan I 36*	Aminoazobenzene Spirit Yellow 31*

* SCHULTZ, *Farbstofftabellen*, Berlin, 1914.

** HELLER and MERTZ

Rabbits were mainly used as subjects of the experiments, but observations with some dyes were also made on a few cats and on rats. The results are summarized as follows:—

Oil-soluble and water-insoluble dyes administered to different animals are eliminated in the urine and in the bile. Elimination in the urine was mainly inhibited in poisoning with zinc or oil of chenopodium.

Two of the compounds of benzeneazophenol and benzeneazoresorcinol, which were isolated from the urine of rabbits, proved to be conjugated with glucuronic acid.

Most of the dyes were deposited in the adipose tissues; staining of the nervous tissue, the kidney, and muscle was also observed in some experiments.

Ten to 15 hours after intravenous injection of 25 mgm. per kilo of benzeneazoresorcinol, the dye was still present in the blood.

The toxicity of the different dyes was not pronounced even when larger doses were administered.

3— **Copper in Certain White Wines, in Chocolate and in Beans.** — See No. 683 of this Review.

3— **Report on the Agricultural Control Stations of Holland for the Year 1916-1917.**

— Communication from the Dutch Minister for Agriculture, in *Verslagen en Mededeelingen van de Directie van den Landbouw*, 1917, No. 4, pp. 88 + Tables. The Hague, 1917.

By Royal Decree of September 6, 1915, the Royal Agricultural Stations Holland ("Rykslandbouwproefstations") were divided into 2 classes: experiment stations and control stations. The experiment stations are at Arnhem and Hoorn; their reports are published regularly under the title

of "*Verlagen der landbouwkundige onderzoekingen van de Rykslandbouwsproefstations*". The bulletin under review contains the reports, for the year 1916-1917, of the following control stations: -- *Wageningen*, control of live stock feeding stuffs; *Maastricht*, control of manures; *Goes*, control of remedies against fungi, etc.; *Wageningen*, seed control.

WAGENINGEN STATION FOR THE CONTROL OF FEEDING STUFFS. — From June 1, 1916 to June 1, 1917, 2467 samples were controlled by making 9893 analyses. The report of this station records a certain number of cases of falsification, chiefly with regard to compound or concentrated food stuffs, the majority of which are made up of products of absolutely no feeding value for live stock, but which are nevertheless sold at excessive prices; this is why, whenever it is possible to obtain simple feeding stuffs, their purchase should be advised in preference to that of any compound feed.

MAASTRICHT CONTROL STATION. — From June 1, 1916 to June 1, 1917, 10027 samples of manures were controlled, 15983 analyses being made. As with the preceding station, numerous cases of falsification were detected; this station also advises farmers who wish to buy artificial manures, in spite of the high price, to require that the nitrogen should be present in either ammoniacal or nitric form and that the phosphoric acid and potassium should be water soluble. On account of the lack of homogeneity of large stocks of fertiliser the station advises the taking of several samples and it distributes a circular free of charge showing how the samples are best taken.

GOES CONTROL STATION. — From October 1, 1916 to June 1, 1917, 2079 samples were examined, including 86 anticryptogamic substances and remedies against parasites, 1468 agricultural products, 243 soil and 58 water samples, 129 dairy products and 32 miscellaneous samples.

WAGENINGEN SEED CONTROL STATION. — From June 1, 1916 to June 1, 1917, 3783 samples were controlled, thus giving an increase of 35% on the previous year's number. Owing to present conditions, the quality of the seeds was very variable. Regional agricultural committees usually judge crops on the spot, calling "seed suitable for sowing" ("voor den zaai geschikt zaad") those that fulfil the required conditions and are suitable for cultivation; those judged in this way by the official district agricultural agent or a representative chosen by him are called "first quality seeds". Judging on the spot is too uncertain and can only give doubtful results; for this reason it is now well understood that accurate and rigorous control is more than ever necessary at the present moment.

CROPS AND CULTIVATION.

621 — **Method for Calculating the Length of the Growing Season at any Period of the Year and in any Locality.** — REED, G. W., in the *Monthly Weather Review*, Vol. XLIV, No. 9, pp. 509-512, Washington, 1916.

To calculate the length of the growing season, it is customary to count the number of days elapsed between the average date of the last destructive spring frost and that of the first killing autumn frost, but, in accepting these average dates as they are the agriculturist would run great risk.

[620-621]

To shed light on the question, the data may be examined that have been collected at the Keokuk Station (Iowa, U. S. A.) where it was found that the average date of the last killing spring frost was April 15, that of the last killing autumn frost was October 15, while the average length of the season without frosts (growing season) was 183 days.

On analysing the statistics collected annually from 1872 to 1914, it will be noted that, out of 43 years, 20 had spring frosts after April 15, so that the degree of safety with regard to frost would be only 53 % in relation to the average date. On the other hand the statistics for the whole of the United States tend in general to confirm the fact that crops suffer from spring frosts every two years (50 % security) and at a date after the average date of the last killing frost.

As for killing autumn frosts, they appeared in 21 years out of 43 before October 15, so that the degree of security, in relation to the average date, varies round 50 %.

Out of the 20 years without killing spring frosts after April 15, there were 8 with autumn frosts before October 15, so that only 12 years of the entire period, or 28 %, really had 183 days without killing frosts, counting from the average date of the last killing spring frost.

To avoid risk of frosts, the farmer should sow or plant at a date sufficiently late so as to be sufficiently safe from spring frosts, but not so late as to prevent ripening before there is risk of autumn frosts. Thus, as has been already seen, the knowledge of the average length of the frostless season alone does not suffice, nor does it correspond to the desired aim.

The article under consideration gives data from which can be calculated the probably available growing season (*i. e.* without frosts) included between a spring period and an autumn period where the degree of security from frosts is very high, in order to forecast a good harvest. The symbols used are as follows:—

s = date of the last killing spring frost in any one of the years under consideration.

a = date of the first killing autumn frost in any one of the years under consideration.

n = number of days elapsed between s and a .

A_s = average date of the last spring frost.

A_a = average date of the first autumn frost.

A = average number of frost-free days.

A'_s = an arbitrary number near to A_s ; d_s = difference between s and A'_s .

A'_a = an arbitrary number near to A_a ; d_a = difference between a and A'_a .

A'_l = an arbitrary number near to A_l ; d_l = difference between l and A'_l .

o = number of days of observation.

$\sigma_s, \sigma_a, \sigma_l$ = average differences from s, a , and l .

$\Sigma d_s, \Sigma d_a, \Sigma d_l, \Sigma d_s^2, \Sigma d_a^2, \Sigma d_l^2$ = algebraic sums of $d_s, d_a, d_l, d_s^2, d_a^2, d_l^2$.

In Table I are reproduced figures, quoted from those obtained at Keokuk for the first and last quinquennial periods of 1872 to 1914.

TABLE I. — *Data on Spring and Autumn Frosts at Keokuk.*

Year	Last spring frost			Last autumn frost			d_s	d_a	Frostless season		
	s	d_s	d_s^2	a	d_a	d_a^2			l	d_l	d_l^2
1872	April 16	+ 1	1	October 6	— 9	81	—	9	173	— 10	100
1873	" 25	+ 10	100	" 6	— 9	81	—	90	164	— 19	361
1874	" 23	+ 8	64	" 23	+ 8	64	+	64	183	0	—
1875	May 2	+ 17	289	September 18	— 27	729	—	459	139	— 44	1936
1876	April 2	— 13	169	October 7	— 8	64	+	104	188	+ 5	25
1910	April 25	+ 10	100	October 22	+ 7	49	+	70	180	— 3	9
1911	" 9	— 6	36	" 22	+ 7	49	—	42	196	+ 13	169
1912	" 3	— 12	144	" 23	+ 8	64	—	96	203	+ 20	400
1913	" 13	— 2	4	September 22	— 23	529	+	46	162	— 21	441
1914	" 12	— 3	9	October 27	+ 12	144	—	36	198	+ 15	225
Sums . . .	—	— 30	5904	—	+ 5	8487	—	1111	—	+ 88	144
Means . . .	April 15	—	—	October 15	—	—	—	—	183	—	—

The formula : $\sigma = \sqrt{\frac{\sum d^2}{n} - \left(\frac{\sum d}{n}\right)^2}$ is used for calculating the standard deviation σ . On substituting the values given in Table I for the symbols we have, for σ_s , σ_a , and σ_l :

$$\sigma_s = \sqrt{\frac{5904}{43} - 0.40^2} = 11.7 \text{ days}; \quad \sigma_a = \sqrt{\frac{8487}{43} - 0.01^2} = 12.3 \text{ days};$$

$$\sigma_l = \sqrt{\frac{14612}{43} - 0.66^2} = 18.4 \text{ days}.$$

Once the standard deviation is known, it is easy to find the probability of frost or the degree of safety for any time, by the aid of Table II, based on the theory of probabilities.

TABLE II. — *Determination of the dates corresponding to the various probabilities of frost and to the various degrees of security.*

Probability of frost	Degree of safety	Calculation of the dates	
		Spring	Autumn
50 %	50 %	A_s	A_a
40	60	$A_s + 0.25 \sigma_s$	$A_a - 0.25 \sigma_a$
30	70	$A_s + 0.52 \sigma_s$	$A_a - 0.52 \sigma_a$
25	75	$A_s + 0.67 \sigma_s$	$A_a - 0.67 \sigma_a$
20	80	$A_s + 0.84 \sigma_s$	$A_a - 0.84 \sigma_a$
10	90	$A_s + 1.28 \sigma_s$	$A_a - 1.28 \sigma_a$

Thus, multiplying 0.52 by 11.7 (σ_s) and adding the product (nearly to the date April 15 (A_s)), the date April 21 is obtained, when the probability [621]

of frost is reduced to 30 %, while it is 50 % on April 15. For the autumn a similar calculation is made, but the product obtained is subtracted from A_s .

The degree of safety for a given period as regards frost is obtained by multiplying the degree of safety for the beginning of the period by the degree of safety for the end of the period. Thus, for example, on April 15 and October 15 the degree of safety is 50 %; for the period April 15 - October 15 the degree of safety would be $0.50 \times 0.50 = 0.25$, or 25 %, i. e., very close to the value obtained on counting the cases directly.

The agriculturist would run great risks, if he only based his calculations on the average length of the frost-free period. In fact, as is shown in Table II, the degree of 70 % of safety is obtained: in spring, 0.52 σ_s days after the average date of the last killing frost; in autumn, 0.52 σ_a days before the average date of the first killing frost — that is, April 21 and October 8 respectively. For the period of 170 days included between these two dates, the degree of security is about 50 % ($0.70 \times 0.70 = 0.49 = 49$ %). The risk would still be great.

For a crop to succeed, there must be a degree of safety of at least 80 %, that is, there must be at least 4 good years out of 5. In this case, the degree of safety at the beginning and end of the frost-free period must be 90 % ($0.90 \times 0.90 = 0.81 = 81$ %). In the case of Keokuk, by calculating the value of $A_s + 1.28 \sigma_s$ and $A_a - 1.28 \sigma_a$, the two dates April 30 and October 1, are obtained which have the degree of 90 % safety; this means that, in that locality, the degree of safety is 90 % for the 153-day period included between April 30 and October 1; in other words, as far as risk of frosts is concerned, any crop may be sown and harvested successfully.

(2) — **The Relation of Weather to the Amount of Cotton Ginned during Certain Phases of the Harvest.** — KESLER, J. B., in the *Monthly Weather Review*, Vol. XLV, No. 1, pp. 6-10, 2 Figs. Washington, 1917.

During the cotton harvest, the U. S. Bureau of Census, Department of Commerce, issues periodical reports as to the cotton ginned during the following harvest periods:— September 1 and 25; October 18; November 1 and 14; December 1 and 13; January 1 and 16.

In order to resolve the question of the influence of weather on the amounts of cotton ginned during these periods, a series of researches was carried out in the cotton belt; the present article discusses the results thus obtained.

The growth of cotton has strictly geographical limitations, established largely by temperature conditions, as the plant requires a mean summer temperature of about 78° F and an average frostless season of about 200 days. The higher the temperature is during the active growing season, principally in May and June, the earlier will be maturity, and the bigger the crop.

For example, Table I gives the data obtained for the State of Oklahoma for the period 1905-1915, as regards the influence of temperature on yield. Column II shows the number of bales, of 500 lb. each, ginned up to October 18, to the nearest thousand bales; thus the first number, 179, shows that, out

of 1000 bales total yield, 179 were obtained up to October 18; this number is 112 less than the average 291. Column III shows the variations from the average. Columns IV, V, VI and VII show the variations from the normal temperature for the period May to August, while Column VIII shows the variations in temperature calculated for the whole period. Column III and Column VIII correspond almost perfectly; when the average temperature of the period May-August is below the normal, the cotton ginned during the first period of the harvest (up to October 18) is below the average and vice-versa.

TABLE I. — *Relations of the temperatures of the period May-August and the cotton ginned during the first period of the harvest in Oklahoma.*

I Years.	II Bales ginned up to October 18	III Departure from average yield	Temperature departure from normal, in °F				VIII Average daily departure from the normal temperature, May-August in °F.
			IV May	V June	VI July	VII August	
1905 . .	179	- 112	+ 0.2	+ 1.8	- 2.8	- 0.1	- 0.9
1906 . .	199	- 92	- 0.1	- 1.4	- 4.2	- 3.1	- 8.8
1907 . .	240	- 51	- 0.8	- 1.4	+ 0.2	+ 2.0	- 6.0
1908 . .	133	- 158	- 0.6	- 1.0	- 2.5	- 0.9	- 5.0
1909 . .	329	+ 38	- 1.5	+ 0.9	+ 3.3	+ 3.3	+ 6.0
1910 . .	422	+ 131	- 2.2	+ 0.5	+ 2.7	+ 0.1	- 1.1
1911 . .	397	+ 106	+ 4.0	+ 8.3	+ 0.3	- 0.6	+ 11.4
1912 . .	308	+ 107	+ 3.6	- 2.2	+ 2.9	- 1.2	- 3.7
1913 . .	391	+ 100	+ 2.8	+ 0.2	+ 3.7	+ 4.8	- 11.5
1914 . .	451	+ 160	- 0.6	+ 5.4	+ 4.6	- 1.0	+ 8.4
1915 . .	66	- 225	- 1.7	- 2.0	- 2.1	- 7.0	- 12.8

Mean 291

Data are also given for the States of North Carolina, South Carolina, Georgia, Alabama, Mississippi, Texas and Arkansas.

In Oklahoma, close to the northern limit of cotton, all the negative oscillations, even in very advanced stages of development (July-August), have considerable influence on the plant, whose critical period for temperature covers the whole period May-August, whence the positive correlation between the figures of Columns III and VIII. But when going south, temperature below the normal, especially in July and August, are always relatively high and cannot affect the normal growth of the cotton plant, so that the critical time for temperature tends to be limited to May and June. Thus, in Georgia, South Carolina and Alabama, the departures from the normal yield during the first period of the harvest correspond exactly to the departures from the normal temperature during the period May-June. On the contrary, the correlation is much less relatively to the whole period from May to August, on account of the great heat.

The increased maturity due to positive variations in temperature in

May and June is accompanied by an increased yield during the early part of the harvest and, on the contrary, by a decrease during the latter part. Table II gives the data for Georgia. In that State, to the south of Oklahoma, the harvest begins much earlier than in the latter State, the first period ending on September 1, instead of October 18. The variations in yield, which are usually positive and occur during the first and second periods of the harvest (up to September 25), correspond to positive variations in temperature, as do the variations, usually negative, during the following periods (after September 25), and vice-versa.

TABLE II. — *Departures from the average yield during various ginning periods; average daily temperature departures from the normal during May and June in Alabama.*

Year	Up to September 1	Departures from the average yield, in percentages ginned					Average daily departure from the normal temperature during May-June
		From Sept. 1 to 25	From Sep. 25 to Oct. 18	From Oct. 18 to Nov. 1	From Nov. 1 to Nov. 14	From Nov. 14 to Oct. 1	
1904	+ 1.2	+ 2.1	- 6.4	- 0.5	+ 1.1	- 0.8	+ 3.5
1907	+ 1.0	+ 1.5	- 0.2	- 2.4	- 2.8	- 0.6	- 1.3
1905	+ 2.9	+ 6.8	- 1.2	- 1.3	- 2.1	- 1.9	- 3.9
1915	+ 3.1	+ 8.9	- 4.5	- 2.2	+ 0.9	- 2.1	- 0.4
1908	- 0.5	+ 1.6	+ 2.2	- 1.5	- 1.0	—	- 1.9
1906	- 2.3	- 5.4	- 2.5	+ 2.3	- 1.7	+ 3.2	- 4.8
1913	- 0.7	- 5.3	+ 6.0	- 1.9	+ 0.7	+ 1.5	+ 4.3
1912	- 1.9	- 8.0	+ 0.1	+ 2.5	+ 2.2	- 3.9	- 1.6
1909	+ 1.9	+ 2.2	+ 2.8	- 0.4	- 0.5	- 2.8	- 1.3
1907	- 1.9	- 4.0	+ 0.1	+ 2.3	+ 0.1	- 1.0	+ 5.3
1910	- 2.7	- 2.0	+ 1.8	+ 3.0	+ 0.9	+ 1.5	+ 2.9

Another weather factor, of less importance than that of temperature, but worth consideration, is that of the number of fair days; the more there are, other conditions being equal, the greater will be the yield during the corresponding periods. As regards this point, Table III gives the figures obtained in Alabama for the period from September 25 to October 18; it will be seen from the almost completely identical figures of columns II and V that the correlation between the two groups reaches the maximum; the positive or negative departures in the number of clear days correspond to similar departures in the yield.

The planters and cotton brokers attach considerable importance to the reports of the Bureau of the Census regarding the amounts of cotton obtained during the first or first two periods of the harvest, as the value of cotton depends largely on the amount grown. A forecast of the size of the cotton crop, based on the ginning reports, has a much greater value when consideration is given to the influencing weather reports, as has been pointed out, than when the reports alone are considered.

TABLE III. — *Relation between the cotton ginned and the number of clear days for the period from September 25-October 18, in Alabama.*

I Year	II Amount ginned in % of the total yield	III Departure from average yield	IV Fair days, in percent of the total number of days	V Departure percentages of clear days
1905.	25.5	— 1.6	78 %	— 5
1906.	19.9	— 7.2	65	— 16
1907.	25.1	— 2.0	78	— 1
1908.	28.4	+ 1.3	83	+ 6
1909.	31.2	+ 4.1	87	+ 8
1910.	27.2	+ 0.1	74	+ 12
1911.	28.3	+ 1.2	82	+ 4
1912.	30.1	+ 3.0	70	— 1
1913.	34.6	+ 7.5	91	+ 8
1914.	24.2	— 2.9	65	— 14
1915.	23.9	— 3.2	70	— 3
Means	27.1	—	77	—

For example, if temperatures during the critical months of growth are high and the weather be favourable for picking during the first period, it may be taken that the yield during that period will be high, while the final yield will be much less than that apparently indicated by the actual amount ginned to that date.

On the other hand, if the temperature is low during the growing period (retarded maturity) while rainy days retard the harvest at the beginning, the yield of the first period will be low, but as the successive yields will be high the total yield will be higher than that calculated on the basis of statistics for the first period.

Again, when the temperature is high during the growing period and there are rainy days at the beginning of harvest, or, on the contrary, if the temperature is low during the growing period, with clear days at harvest time there will be, in these 2 cases, two groups of phenomena tending to neutralise each other and the statistics for the first crop will allow a forecast of the final yield to be made with greater accuracy without the need of making corrections for early or late maturity.

To obtain a good forecast of the final crop (total yield of all the period of harvest), by using the meteorological and statistical data for a single period, the author proposes the use of the equation: — $X = \frac{a}{bc}$ where X is the approximate total crop; a , the number of bales ginned during the period; b , the percentage of the total crop ginned on the average (for series of years) for each fair day of the period; and c , the number of fair days during the particular period.

To gain an idea of the accuracy of the information obtained by using this formula, it will be seen from Table IV that the figures of columns VI and

VII closely approximate; the error being never greater than 5 %, and averaging about 2.5 per cent.

TABLE IV. = *Forecast of the total yield of ginned cotton in Georgia, based on statistics for the crop-period September 1 to November 14, using the formula $X = \frac{a}{bc}$.*

I	II	III	IV	V	VI	VII	VIII
Year	Percentage of total crop ginned during the period	(a) Number of fair days during the period	(b) $\frac{II}{III} = 1.281$	(a) Number of bales ginned during the period	(x) Computed approximate crop $x = \frac{a}{bc}$	Actual crop	Percentages of computed error
1905 . . .	76.7 %	61 %	78.1	1 323	1 694	1 725	1.8 %
1906 . . .	71.6	56	71.7	1 118	1 629	1 613	0.2
1907 . . .	72.7	58	74.3	1 354	1 822	1 860	2.0
1908 . . .	75.8	62	79.4	1 499	1 888	1 977	4.5
1909 . . .	78.6	61	78.1	1 454	1 862	1 850	0.6
1910 . . .	78.2	60	76.9	1 417	1 843	1 812	1.7
1911 . . .	70.6	54	69.2	1 971	2 048	2 794	1.9
1912 . . .	71.6	54	69.2	1 297	1 874	1 813	3.4
1913 . . .	74.6	57	73.0	1 751	2 399	2 346	2.3
1914 . . .	70.8	58	74.3	1 972	2 594	2 723	4.7
1915 . . .	77.6	58	74.3	1 504	2 024	1 938	4.4
Means	74.4	58.1	—	—	—	—	2.5 %

(23) — *Researches on Certain "Soil Sicknesses" in the Netherlands.* — SÖLMGEN, N. L., KNETEMANN, A. and WIERINGA, K. T. (Royal Agricultural Experiment Station of Groningen), in *Verslagen van Landbouwkundige Onderzoekingen der Rykslandbouwpromotions*, No. XXI, pp. 121-165 + 2 Photos, 4 Tables, 6 Fig. The Hague, 1917.

The recent appearance of various "soil sicknesses" in Holland, Germany and Denmark has lead the authors to undertake the researches described below. These sicknesses are shown by a loss in fertility of the soil, areal crops being particularly affected. The first case, which appeared in 1905, was called "haverziekte" (oat disease) by SJÖLLEMA and HUDIG, who attributed it to an excess of bases in the soil; it corresponds to the "Dörrfleckenkrankheit" described in Germany in 1914 by KRÜGER and KIMMER. Since then, fearing to make the soil too alkaline, dressings of lime have been given more and more rarely in certain localities, with the result that, in 1913 and 1914, another soil sickness appeared at Hooghalen, which HUDIG called "Hooghalensche ziekte" (Hooghalen disease). This disease chiefly affects cereals, but beets and potatoes also suffer from it. As a strongly alkaline manuring does away with the sickness and as a strongly acid manuring can, on the contrary, cause the sickness in healthy soil, it is attributed, inversely to the preceding one, to excessive soil acidity.

I. — PREVIOUS RESEARCHES. — To explain the origin of the disease,

other experimenters, especially ABERSON, have thought that other factors were responsible : — 1) the hydrogen-ion concentration of the soil ; but researches have shown that the differences found between its values in healthy and sick soils are too small to have any influence ; 2) excess of nitrites, due to *Bacillus nitrosus*, which actively transforms nitrates into nitrites ; in fact, a minimum amount of nitrites, only a few milligrams per kilo, suffices to stop the growth of plants and even kill them.

The present report includes the authors' researches on the acidity of the soil and its influence on vegetation ; the intervention of the micro biological factors will be dealt with in a further paper.

Properties of Humus. — The numerous researches on the properties of humus (1) have resulted in a great diversity of opinion as regards the physical and chemical properties of this complex compound. There are 2 chief opinions : — according to SPRENGEL, MULDER, KISSLING, TACKE and SVEY ODEX the fundamental properties of humus are due to the presence of acid radicals ; while according to VAN BEMMELEN and BAUMANN, they are due to its colloidal nature.

II. — DETERMINATION OF THE CONTENT OF FREE AND COMBINED HUMIC ACID AND THE LIME REQUIREMENT. — A) WITH THE HELP OF CULTURE OF AZOTOBACTER. — 1) The authors adopted the method used by CHRISTENSEN (State Laboratory at Copenhagen) (2) in order to ascertain the soil reaction as regards the cultivation of cereals, so as to be able to control soil sicknesses in this way. Having found that *Azotobacter* was not present in soils receiving no lime, he conceived the idea of growing that organism on various soils, as an index of their acidity or basicity. He proceeded as follows : —

In 2 Erlenmeyer flasks are placed 50 cc. of distilled water, 2 % mannite, 0.2 % of bipotassium phosphate and 5 gm. of soil ; the mixture is inoculated with the bacterium and incubated at 26° C. One flask receives a piece of chalk and serves as a control. According to whether the culture grows or not in the flask without chalk, the soil in that flask is called basic or acid.

By using this method the authors found that soil causing the oat disease did not favour the growth of the bacterium, while soils affected with Hooghalen disease, on the contrary, did, so that this microbiological method is very efficacious for ascertaining the soil reaction.

2) To determine the amount of lime required to render a hyperacid soil healthy the bacterium was again used, by adding increasing amounts of lime. The use of two species : *Azotobacter Vinelandii* and *A. chroococcum*, the former able to grow at a slightly higher degree of acidity than the latter, easily allowed of the estimation of the limit of the quantity of lime required, which is that which suffices for the growth of the first species, while it is insufficient for the second. The quantities found in

(1) See also R., January 1918, No. 8. (Ed.)

(2) See R., 1916, No. 843 and R., 1917, No. 996. (Ed.)

this way agree quite well with those obtained with the diffusion method and the probability of error is reduced to ± 1784 lb. per acre.

B) BY THE AID OF A DIFFUSION METHOD ON AGAR PLATES STAINED INDICATORS. — The authors made use of a diffusion method based on the fact that acids and bases, even when difficultly soluble, diffuse in a hydrogel.

If a series of small cavities are made by means of a bent, nickel spatula in a layer of agar coloured by an indicator, taking care not to pierce the agar, acids or alkalis placed in these cavities develop a surrounding zone of acid or alkaline diffusion in the agar, shown by the indicator. The sensitivity of agar coloured by litmus is very great; a $N/1000$ solution of acid or alkali gives a very distinct effect; that of a $N/5000$ solution is still perceptible.

1) *Determination of the free humic acid content, expressed in mgm. of CaCO_3 per 10 gm. of dry soil.* — This is done in a similar way to the previous one by adding increasing quantities (5 mgm. a time) of CaCO_3 to the specimens. After heating for 3 hours at 100°C . to drive off the CO_2 so as to avoid error, small samples are taken and placed in the cavities in the agar plate. Humic acid gives a red zone of diffusion, CaCO_3 or $\text{CaH}_2(\text{CO}_3)_2$ a blue zone, and calcium humate a neutral zone. The accuracy with which the free humic acid content can be ascertained is expressed in mgm. of CaCO_3 per 10 gm. of dry soil, 5 mgm. for a soil that has lost 10 % by calcination, which corresponds to an error of 1071 lb. per acre; although this seems large, it should be noted that a strongly hyperacid soil often requires 3706 lb. of lime per acre to make it healthy.

2) *Determination of the excess of alkalis in a hyperbasic soil.* — The excess of alkalis still present with the humates can be determined by adding increasing amounts of HCl , instead of CaCO_3 , to various 10 gm. samples. The amount of HCl required to neutralise the 10 gm. of analysed soil on the agar layer represents the excess of alkalis. In this way some "hyperbasic" soils were found to contain an excess of nearly 26765 lb. of lime per acre.

3) *Determination of the total humic acid content (free and combined) and the calculation of the respective percentages of free and combined acid.* —

a) The metals combined with the humic acid are separated by dialysis with $N/10$ hydrochloric acid, or by boiling the sample with the same solution, then filtering and washing with distilled water till the Cl ions are completely eliminated. The entirely free humic acid is then titrated on the agar plate. b) To determine the combined humic acid content (always expressed in mgm. of CaCO_3 per 10 gm. of dry soil) it is sufficient to subtract the known content of free acid from the total content of humic acid.

III. — APPLICATION OF THE RESULTS. — The authors have analysed a great many soil samples. For any soil, whether sand or peat, acid, neutral, or alkaline, the humic acid per gram of loss on calcination includes about 80 mgm. of CaCO_3 . The humus of different soils therefore contains a constant amount of humic acid per unit of weight. It thus results that: 1) the total humic acid content may be determined directly, and the HCl method described above neglected, if the following are known: — a) wa-

ter content; b) the loss on calcination (by means of which the total content in organic matter can be calculated); c) the free humic acid content.

2) the too-acid or too-basic character of the soil depends on the percentage of free humic acid, i. e., the ratio *free humic acid : combined humic acid*. A "hyperacid" soil contains more than 60 % of free humic acid; a healthy soil, from 50 to 60 %; a "hyperbasic" soil, from 0 to 50 %; in other words if the ratio is $> \frac{6}{10}$ the soil is "hyperacid"; if the ratio is $< \frac{5}{10}$ and > 0 the soil is healthy. The best percentage of free humic acid seems to be 25%.

Influence of Fertilisers on these Sicknesses. — Certain salts, by altering the percentage of free humic acid, especially near the roots, can have either a bad or good influence. For example, with potassium chloride, the calcium largely takes the place of potassium, and by washing is lost as soluble chloride; as the potassium is utilised by plants, the result is an increased content of free humic acid. Magnesium chloride and ammonium sulphate have a similar effect. The contrary effect is produced by substances that diminish the content of free humic acid, as a result of the formation of compounds that can be assimilated by plants: lime, magnesium carbonate, sodium carbonate, sodium nitrate.

Control of the Authors' methods. — The results obtained with TACKÉ method (determination of the free humic acid content by estimating the CO_2 produced by the reaction $\text{soil} + \text{CaCO}_3$) gave results that agreed with those obtained by the methods described in the present report. On the contrary, no efficient control could be made by comparing the results with those furnished by the method based on the determination of the hydrogen ion concentration or by that based on the determination of the electric conductivity (SVEN ODÉN).

GENERAL CONCLUSION. — The direct and immediate cause of the appearance of these "soil sicknesses" has not yet been determined, but the close relation between their appearance and the free humic acid content of the soil has been established, a relation that enables the soil to be rendered healthy by means of suitable treatment.

624 — **Studies on Nitrification in Natural Soils and Its Importance from an Ecological Point of View, in Sweden.** — HESSELMANN, H. (Meddelanden från Statens Skogsförsöksanstalt), in *Skogsvärldsföreningens Tidskrift*, Year XV, No. 4-6, pp. 312-346 + 1 Figs. Stockholm, 1917.

A consideration of the chief researches carried out of recent years on the chemical composition of the soil and the formation of humus (SUZUKI, ROBINSON, SCHREINER and collaborators, BAUMANN & GULLY, RINDEL, ODÉN), especially as regards forest soils, leads to the following conclusions:

1) From a soil containing relatively little humus, and, to a less degree, peat, organic compounds of definite composition can be isolated; in certain cases, the compounds thus isolated and identified form a considerable part of the soil humus.

2) Many kinds of humus, especially those of dark colour, are largely formed of chemical compounds of undefined character.

3) The acid reaction of some humiferous soils is due to the presence of free organic acids.

4) The constituents of humus are mostly of colloidal nature, and, on account of this, the physical structure of humiferous soils is greatly influenced by the content in mineral salts or electrolytes of the soil or soil water.

The author distinguishes 2 types of humiferous soils: a) "sweet" humiferous soils, well aerated by the action of worms and insects; b) "strong" humiferous soils, formed of dead decomposed or decomposing vegetation. The former are characteristic of deciduous forests and, to a lesser degree, of the forests on soils rich in inorganic salts; the latter, on the contrary, are found in pine forests of the ordinary type and often form a series of layers with varying stages of decomposition and which can be clearly separated from the mineral sub-soil.

The formation and distribution of nitrates in the soil directly influence its productive capacity. The dead covering always contains a certain amount of nitrogen and the knowledge of the processes by which the nitrogen becomes changed into assimilable compounds is of great importance. It is well known that the decomposition of humus is accompanied by a liberation of ammonia, which can be directly assimilated by certain plants. To determine the "degradation capacity" of a soil, it is inoculated with a sterile solution of peptones, and incubated for several days; the degree of decomposition is then ascertained by adding magnesia to the peptone solution and stilling off the ammonia into sulphuric acid. Though there are many organisms that can break up organic matter with the formation of ammonia, to the present few are known that can change ammonia into nitrites and nitrites into nitrates: such are the nitrosobacteria and nitrobacteria discovered by WINOGRADSKY. As nitrobacteria can only act on ammoniacal compounds, the formation of ammonia appears to be an essential phase of nitrification in humiferous soils; denitrifying bacteria are also commonly found in humiferous soils, but, under normal conditions, the nitroso and nitrobacteria are much more active than the others.

According to the author, the sources of nitrogen in forest soils are: —

a) the dead, decomposing covering, to the nitrogen of which is added the atmospheric nitrogen fixed by leguminosae, alders and other plants;

b) the soil fungi and bacteria which can fix nitrogen, and which renew the energy required for this fixation by decomposing the organic matter in the soil;

c) the ammonia and nitric acid brought to the soil by rain.

In naturally wooded land, the second factor is the most important one. The nitrogen of forest soils is lost in 3 ways: a) loss of nitrates dissolved in soil water; b) activity of denitrifying agents; c) removal of wood.

The preceding researches on nitrate formation in forest soils were carried out along 3 lines: — a) the examination of soil samples to find if nitrifying bacteria were present; b) determination of the nitrifying capacity

of the samples; c) determination of the nitrogen content of the trees and plants at different seasons.

The author applied these different methods to the detailed study of different types of forest, obtaining the following conclusions: —

The "sweet" humus of beech woods contains as many nitrifying and denitrifying bacteria distributed in all its mass; herbs and grasses also help considerably to increase the stock of nitric nitrogen in such a type of soil; samples of this type of soil can form considerable amounts of nitrates if they are kept. The humus of pine forests with a mossy covering is characterised by the absence of bacteria capable of nitrifying ammonium sulphate; denitrifying bacteria are also not present and no potassium nitrate can be found in the tissues of the plants covering the soil. The normal requirement of nitric nitrogen for this kind of forest must evidently be satisfied in some other way than by assimilation of nitrates. As regards the acidity of the dark humus soils of pine woods, the author observes that as the colloids were coagulated by the addition of inorganic salts, it must be admitted that the humus lying on a subsoil very rich in soluble inorganic salts is less likely to give an acid reaction, because the humus particles unite and become granular, thus allowing the penetration of roots, worms and insects, all factors that favour the aeration of the soil. To support this theory, the author quotes as an example the fact that the water of peatbogs and marshy soils of the forests of Norrland on basaltic sub-soil is brown and turbid, while the same water in the limestone forest soils of Jemtland is limpid and clear.

The author remarks that, in spite of the importance of the researches carried out in the United States with the object of isolating numerous organic decomposition products partly toxic to plants, their significance should not be exaggerated, as there is not the slightest proof that such substances are present in the dark-coloured and acid humus of coniferous forests.

Many natural soils have the power of nitrification and it is characteristic that humus formation in such soils takes place under the influence of electrolytes or solutions of inorganic salts; the formation of "sweet" humus is facilitated by the action of insects and worms that mix the soil water and humus. This is why humification, during the seasons when the salt-charged soil water flows rapidly, gives rise to forms of humus lacking the power of nitrification. On the other hand, on account of its physical constitution, "sweet" humus nitrifies, which does not take place with "strong" humus. In many places, nitrification is so rapid that a considerable amount of nitrogen accumulates in the covering vegetation; this is best seen in dense beech, elm, oak, ash, and alder forests, especially where there is moving underground water; in the higher mountainous regions, the soil covering also contains a considerable amount of nitrogen. In woodlands and spruce forests with grassy soil covering the nitrogen of the humus nitrifies without there usually being a resulting accumulation of nitrogen in the layer. On the contrary, plant associations on bare rocky soils are often composed of nitrophilous species that accumulate nitrogen in their tis-

res. Again, in pine forests with a covering of lichens and mosses, the nitrogen is not nitrified and the decomposition of the dead covering gives rise to the formation of ammonia and its compounds.

Soils where nitrification is in progress are often acid and, in this case, all only slowly change ammonium sulphate to nitrate, whilst the denitrifying bacteria are usually found distributed among the moss. On the other hand, natural soils can, during nitrification, accumulate as much nitric nitrogen as ordinary cultivated soils.

Nitrification is not only largely influenced by the origin of the soil, but also by the climate, and as the degree of nitrification constitutes a powerful factor determining the composition of the plant associations of a given soil, the factors of the formation of the soil can have a decisive influence, in certain cases, on that composition. Thus, the same forest trees grow more rapidly on soils where nitrification takes place than where there is no nitrification, and a suitable forest system should make it possible to do in numerous forests in such a way as to favour soil nitrification, thus assuring a higher yield of wood; nevertheless, a good yield of pine and spruce wood can be obtained on soils where there is no nitrate formation; in this case, however, the rate of growth appears to be proportional to the rate of ammonification and the formation of the soil might well be influenced by a suitable system of forest management.

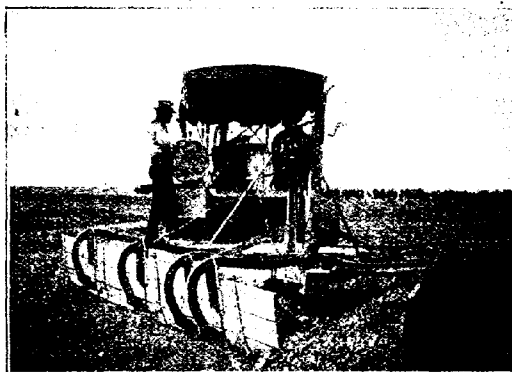
In conclusion, it should not be forgotten that lime, both in the soil and in water, favours nitrification.

The text is illustrated by 28 photographs, constituting a useful series of biological documents.

3 - **Irrigation of Rice in California, U. S. A.** -- ROBERTSON, R. D., in *Bulletin No. 279, University of California Publications, College of Agriculture, Agricultural Experiment Station*, pp. 254-270. 7 Fig., 3 Tables. Berkeley, May, 1917.

Approximately 67 000 acres of rice were irrigated in California in 1916, the water supply being obtained principally from Sacramento and Feather rivers. Only about 37 000 acres were irrigated by pumping from wells. The land is prepared for irrigation in contour checks, preparation consisting mainly in making ditches and levees and installing gates. The gates must be wide enough to admit the large heads of water used in the initial floodings. The levees are made by means of implements described in the bulletin and amongst which the "ridger" is worthy of note. This implement, which is hauled by a tractor, is a simple, home-made affair. The appended figure shows a ridger in use, which can regulate the size of the levee. The runners for the sides are made of 3-in. \times 12-in. plank, 10 ft. long and lined with steel. The front is 10 ft. wide on the bottom and the rear end 3 ft. wide on the bottom. The sides are 2 ft. high and slope outward. This implement makes a levee having a base of about 5 ft. and a height when settled of about 12 in.

On fairly even ground a crew of 2 or 3 men with a tractor will check 30 acres or more per day. Often the work is contracted and a common rice paid is \$50 per day for the use of the tractor and checker.



Ridger for making irrigation levees.

The irrigation season is divided into two periods. Frequent light irrigations with relatively large heads of water are given to germinate the seed and to maintain growth until the plant is 4 to 6 in. high, and thereafter the land is continually submerged to a depth of 6 to 8 in. until the rice is mature.

Measurements of the use of water in 1916 on 18 typical fields in Sacramento Valley showed a range of from 4.27 to 14.83 acre-feet per acre, an average depth applied of 8.23 feet and an average of 47 acres served per cubic foot per second.

The water used was measured by means of a standard contracted weir and an automatic register; the measurements are given in two tables.

Experiments in rice irrigation were made in 1914 to 1915, inclusive, in cooperation with the Bureau of Plant Industry, U. S. Dept. of Agriculture, on the Biggs rice field Station, the object being to determine the effect of varying irrigation treatments on the crop yield.

The results are given in the appended table (page 667).

The tests were made on $\frac{1}{8}$ -acre plots enclosed by well-constructed levees and arranged so that they could be irrigated and drained separately.

The results of the experiments show that, on the black clay adobe soil near Biggs, 30 days after emergence of the plant is the best time for commencing submergence, and that 6 inches is probably the best depth of submergence. Very poor yields were obtained where no water was held on the land. Varying the depth of water had very little effect on plant growth. More uniform temperatures of the water were found with the greater depth of submergence.

£4.14.0 to £5.6.0 per cwt., whereas clover costs from £7.2.0 to £8.2 per cwt.

Besides the black medick and clover recommended by M. BRÉTIGNIÉ M. SCHRIBAUX also advises the use as green manure of crimson clover, which is to be recommended on account of its rapid growth and the relatively low cost of its seed. Fenugreek might also be useful for the same purpose, especially in the south of France, on account of its hardness and well developed roots. The adoption as a green manure of white melilot, already used as such in America, might also be studied.

627 - **Fertilizers in South Africa** — in *The South Africa Journal of Industries*, Vol. No. 5, pp. 465-467. Pretoria, 1918 (1)

The growing scarcity of fertilizers has long been evident to the South African agricultural community, and the Minister of Mines and Industries in his address to the Scientific and Technical Committee at their inaugural meeting in Capetown on April 17, 1917, especially commended this urgent question to their consideration as an important subject for investigation and research.

In accordance with this mandate the Committee at once commenced inquiries in various directions, especially with the object of ascertaining what practical possibilities existed of replacing imports by locally manufactured fertilizers. The large amount of fertilizer imports and their steady decrease since the war began are illustrated in the following table, but the present time importation has practically ceased, and there is no available supply to make good the deficiency.

Imports into South Africa of Manures and Fertilizers, 1913-16
(compiled from *Eleventh Annual Statement of Trade and Shipping*, 1916)

	1913		1914	
	Quantity lb.	Value £	Quantity lb.	Value £
Basic Slag	11 939 558	11 411	13 664 963	13
Bone Manures	9 427 746	20 193	8 800 433	18
Guano	701 553	1 205	2 256 563	4
Nitrate of Soda	146 490	687	50 016	—
Phosphates, raw	1 522 433	1 705	755 100	1
Potash Manures	3 994 560	18 107	1 427 893	6
Sulphate of Ammonia	799 075	4 707	463 120	2
Superphosphates	82 026 036	95 273	73 672 458	88
All other N. O. D.	17 169 069	35 233	18 211 668	45
	1915		1916	
	Quantity lb.	Value £	Quantity lb.	Value £
Basic Slag	18 054 306	21 029	12 461 056	12
Bone Manures	4 038 216	8 776	286 720	—
Guano	1 453 228	2 840	37 644	—
Nitrate of Soda	—	—	2 588	—
Phosphates, raw	—	—	—	—
Potash Manures	61 312	672	—	—
Sulphate of Ammonia	131 175	788	101 224	—
Superphosphates	67 822 467	110 143	40 039 728	89.82
All other N. O. D.	13 095 937	31 679	7 885 294	14.50

(1) See INT. INST. OF AGR. *Production et consommation des engrais chimiques dans le monde* II ed. 1914 and the half-yearly reviews *The International Movement of Fertilizers and Chemical Products useful to Agriculture*, (Ed.)

[626-627]

As is generally recognized, South Africa's fertilizer requirements, in ascending order of importance, are the various forms of phosphoric oxide, nitrogen and potash. South African soils are usually not so deficient in the mentioned item as in the others, and deficiencies can be partially supplied by kraal manure. Phosphates are needed for maize and practically all other crops to promote root growth for withstanding drought and ensuring early maturity, whilst nitrogen is a prime requisite for wheat and sugar crops. The fact that South Africa imports so much of its food supplies under normal conditions (even at the present time wheat and wheat products are imported to the extent of nearly £2 000 000 yearly) makes the present necessity still greater for stimulating local food production, and for this purpose the utilization of fertilizers from various local sources must play the most important part. Apart from the serious drain on the country's wealth by payment for food and fertilizer imports from overseas, the exigencies of a shipping shortage may, as the Minister recently stated in public, cause a total cessation of wheat imports.

The Scientific and Technical Committee has surveyed the problem in various aspects and the inquiries started include: South African guano supplies; the increased employment of green-manuring; the use of ground limestone; the possible utilization of woolwashery and sawdust waste, and kelp for supplies of potash; cotton-seed by-products; locally produced ammonium sulphate; the supply of phosphates from the Seychelles and elsewhere; and the possible utilization of Saldanha Bay and other local phosphate rocks. Eventually the main centres in the Union were visited to investigate abattoir and fishery refuse production, and it was ascertained that much waste existed in the discarding of potential phosphatic-nitrogenous fertilizers. For instance, at the most important abattoir in the Union, 6 per cent. of the offal was buried at considerable cost owing to inadequacy of plant for conversion into a high-grade fertilizer for which the demand exceeded the supply. For similar reasons 12 000 tons yearly of potential crayfish fertilizer was thrown into the sea, and at many other centres waste occurred which, though often individually small, accounted in the aggregate for a considerable quantity. Steps were then taken by the Engineering Sub-Committee of the Scientific and Technical Committee to ascertain whether fertilizer plants could not be locally constructed so as to avoid delay from restriction by machinery importation.

In the meantime strenuous efforts are being made by those interested to convert the large deposits of iron-alumina phosphates known to exist in South Africa into a form suitable for agricultural use, and the technical aspect of this known problem is attracting much attention in South Africa. Inquiries are also being made as to the extent and nature of alleged phosphatic deposits in South-West Africa and elsewhere, and the chemists of the Department of Agriculture and others have periodically published articles on the proper use of fertilizers, great being the need for this educational propaganda.

At the present time about 200 tons per month of ammonium sulphate are being produced from coal at the works of the Natal Ammonium Company

but practically all this is exported to Mauritius for use in sugar growing. Very little is used in the Union, but export is only allowed after all local demands are satisfied. Should the oil-pressing industry in South Africa grow to provide more fully for local glycerine requirements, this would result in increased oil-cake production. Of this by-product, Mafureira (1) and castor oil-cake are unsuitable for stock food, owing to their poisonous properties, but as fertilizers they provide nitrogen and some phosphoric oxide and potash at a cost much less than in the more usual form of nitrogen fertilizers.

628 — **Plants Imported into the United States by the Bureau of Plant Industry of the Department of Agriculture, during the Half-Year July 1 to December 31, 1917:** — U. S. Department of Agriculture, Bureau of Plant Industry, *Inventory of Seeds and Plants Imported by the Office of Foreign Seed and Plant Introduction: I. During the Period from July 1 to September 30, 1914* (Inventory No. 10; Nos. 38 666 to 39 308), pp. 110 + 10 Plate II. *During the Period from October 1 to December 31, 1914* (Inventory No. 11, Nos. 39 309 to 39 681), pp. 67 + 4 Plates. Washington, 1917.

Of the many newly-imported plants the following are mentioned: being of special importance: —

I. — **CEREALS.** — A collection of 13 varieties of the grass *Coix Lacrym-Jobi* (from Burma), some of which produce soft grain and are cultivated for food; 33 varieties or species of the maize characteristic of Copacaban Peru; 5 varieties of maize from Yachow, western China; a collection of sorghum varieties from Java; 20 varieties of rice from Java; the 2 commercial varieties of rice grown in Valencia, Spain (3).

FORAGE PLANTS. — The Australian Rhodes Grass (*Chloris virgata*, var. *decora*) which has done exceedingly well on clay-pan, wind-swept and sun-scorched soils, where other grasses are difficult to grow; 12 species of forage grasses (*Andropogon erianthoides*, *Allotriopsis Ekloniana*, *Eragrostis curvula*, *E. poa*, *Fingerhuthia africana*, *Ischaemum glauco-stachyum*, *Panicum maximum*, *P. nigropedatum*, *Chaetochloa aurea*, *C. Lindergian*, *C. nigrirostris*, *C. sulcata*) from S. Africa, some from the Kalahari desert region, and some from the Transvaal and Caldeon coast district; if any of these plants prove as valuable as the Rhodes grass, from the same climatic district, their introduction will be a decided gain. The following plants are also valuable acquisitions: — 1 cowpea (*Vigna sinensis*), called "in

(1) *Trachilia emetica* Wahl. supplying oleaginous seed, (Ed.)

(2) See R. Feb., 1918, No. 138, (Ed.).

(3) The two commercial varieties of rice grown in the Valencia district, especially on the banks of the Júcar, are the "Benlloch" or "Belloch" and "Amonquili". In 1913, 80% of the first variety and 20% of the second was grown, and the first is being grown in continually increasing quantities. The origin of the "Benlloch" variety is uncertain. It was introduced and distributed to growers by the Agricultural Station of Burjasot, near Valencia. It was immediately acclimatized and seems particularly well suited to the soil. It germinates easily and is resistant to transplanting, which is a common practice in the district; the straw is strong. It ripens, however, somewhat later than the other varieties, and its food value is said to be inferior to that of the "Bomba" variety. In 1913, "Benlloch" rice gave an exceptionally high yield, as much as 4.42 tons per acre, and was sold on the threshing floor at \$4.86 per 220 lb.

umba", grown for food by the Zulus of S. Africa; 1 selected forage gar cane, called "quacsofoa", which in Queensland has proved superior to all the old standard types by its hardiness, yield, softness and food value; *Ianthus rufipilus*, from the Himalayas; *Pollinia fulva*, from the interior of Australia, much relished by cattle; *Eriochloa subglabra* ("capim ango-ha") from Brazil.

VEGETABLES. — A fine variety of the winter "pe-tsai", or Chinese cabbage (*Brassica pekinensis*) with very white heads of a mild flavour; 2 species of rhubarb (*Rheum acuminatum* and *R. nobile*), from Darjiling, India, the two species might be hybridised with *R. rhaponticum*; 22 varieties of cassava (*Manihot esculenta*), representing the most important varieties grown in the State of Bahia, Brazil; a variety of pumpkin (*Cucurbita Pepo*), from the Oasis of Merv, Turkestan, which has withstood the heat and drought of Sonora, Mexico, better than any other variety tested there; 1 long, blood-red carrot (*Daucus Carota*) for pickling, from Sianfu, China; a shrubby species of indigo (*Indigofera dasua*), from the temperate Himalayas, the flowers of which are eaten as a vegetable, while the plant is used for fodder.

FRUIT TREES. — *Feijoa Sellowiana* remarkable for its large fruit (3 ½ to 2 ½ inches) from Pasadena, California; the Pelese apricot from Somma Vesuviana, Italy, with very firm flesh, fine flavour and good shipping qualities; the "wampi" (*Clauccena lansium*) with fruit related to the orange, which promises to be a good stock for the orange and grapefruit; a vigorous tropical vine (*Vitis tiliacifolia*), the fruit of which is good for eating, and which may be used for producing good-quality varieties of tropical grapes; 6 varieties of "kuruba" (*Passiflora maliformis*), the fruit of which is much appreciated in the Bogota market, especially that of a red-fruited variety; *Eriobotrya petiolata*, from the eastern Himalaya district, which may prove valuable as a stock for the loquat; the Luisa mango (*Mangifera indica*) with excellent fruit, from Cuba, though the seed is probably of Philippine origin; a quantity of "litchi" seeds (*Nephelium Litchi*) from trees in the Hawaiian Islands; *Poupartia axillaris*, a fruit and shade tree from the western Hupeh and Szechwan Provinces of China, which has proved hardy in Georgia; *Sorbus cuspidata* and *S. insignis*, natives of the eastern Himalayas; *Dillenia pentagyna*, from Oudh, Bengal, Assam and Burma, the flowers, buds and green fruit of which are eaten by the natives; *Rubus niveus* from Kashmir and Skokim, a Rambler-bearing fruit superior to that of the English blackberry.

ORNAMENTAL, SHADE AND WIND-BREAKING TREES. — The 80-foot high, wild, pink-flowered cherry of Japan (*Prunus serrulata sachalinensis*), which deserves to be widely planted on account of its hardiness and beauty; the Nepal ash (*Fraxinus floribunda*), which, though not hardy in England may prove to be so in the south of the United States; the East African Cedar (*Juniperus procera*) from Eritrea, the wood of which makes better pencils than those of the American juniper; *Balanites Maughanii*, a native of Portuguese East Africa, from the seeds of which a clear, yellow, odourless oil is obtained; *Picea Smithiana*, from Darjiling, India, the wood of which

is used for packing-cases and charcoal; *Aesculus assamicus*, from northern Bengal; *Tilia mongolica* from Tahuashan, China; 3 varieties of the Chinese soap-bean tree (*Gleditsia sinensis*), remarkably resistant to drought and alkalinity, and very ornamental because, all through winter, they bear their pods, which are very rich in saponin; the cigar-boxwood tree (*Toona sinensis*) from Changli, China, a fine shade and ornamental tree which also gives good timber; *Corylus ferox*, the edible Nepalese hazelnut; a large bamboo (*Dendrocalamus Hamiltonii*), from Darjiling, with shoots 80 feet high the young sprouts of which are edible, it might prove hardy in the south of the United States and be used as a windbreak; *Cotoneaster microphylla*, 18 species of Himalayan rhododendron:—*Rhododendron anthopogon* (a shrub about 2 feet high with sulphur-coloured flowers), *R. arboreum* (often attaining a height of 25 feet), *R. arboreum Campbelliae*, *R. arboreum* Smith, *R. barbatum*, *R. camelliaeflorum*, *R. campanulatum*, *R. campylacarpum* (with pale yellow flowers), *R. ciliatum*, *R. Roylei*, *R. Dalhousiae*, *R. Falconeri* (admirably adapted to the parched, arid climate of Tibet), *R. fulgens*, *R. grande*, *R. lanatum* (with pale sulphur-coloured flowers), *R. Lepidotum*, *R. setosum*, *R. Wightii* (with pale yellow flowers); a Nepalese barberry (*Berberis nepalensis*), which, in Nepal, flowers from October to March; *Polygonum vacciniifolium*, an autumn-flowering plant very popular in England; 3 forms of evergreen shrubs (*Euonymus* spp.), from Tahuashan, in the Shensi Province of China.

II. *Edible plants*. — A collection of 38 varieties of Chinese barley, which it is hoped will yield good new varieties in some parts of the United States; 8 varieties of sweet potatoes from the Cuba Experiment Station; 1 wild tomato of Funchal which grows wild among the dry rocks of the Island of Madeira, believed to be from the original stock from which the cultivated tomato is descended, it is very resistant to drought and will probably prove valuable in selection work; the "Mahwa" tree (*Madhuca indica*), the fleshy flowers of which produce annually in India food worth over a million dollars has been imported into Florida and Porto Rico.

LEGUMINOSÆ USED AS GREEN MANURE AND FODDER LEGUMINOSÆ. — The Sarawak bean (*Dolichus Hoseri*) is used as a cover crop to keep down weeds in rubber plantations in the Malay States, and could be used for the same purpose in the citrus orchards of Florida; 1 wild, prostrate form of alfalfa from the mountains between Hotien, Honan, and Luanfu, Shansi province, China.

TEXTILE PLANTS. — The "chingma", also known as Chinese jute or Tientsin fibre (*Abutilon Theophrasti*), which yields a harsher and stronger fibre than Indian jute and is used for carpet-making; it was imported from Ichang, China, and, if improved methods for extracting the fibre be found, may prove of value in America; seeds of *Kokia drynarioides* (closely related to cultivated cotton, but now almost extinct) have been imported from Molokai.

ORNAMENTAL AND WIND-BREAKING TREES. — The "doorn-boom" of the S. African veldt (*Acacia horrida*) is promising as a hedge and wind-breaking tree in Texas; 2 species of Tamarix (*Tamarix pentandra* var. *brachystachys* and *F. Karelini hirta*) have been imported from the desert

Farab, Bokhara, Turkestan, in view of the good results obtained in Texas with *Tamarix* as low windbreaks; the Himalayan *Rosa odorata gigantea*, with white flowers 6 inches across, a climbing rose which may be grafted with others; the most beautiful flowering tree of Java, *Spathodea spanulata*, imported from Africa into the island, where it flowers almost the year; as it has flowered in southern Florida new importations have been made.

FRUIT TREES. — The rapid growth of avocado (*Persea gratissima*) groves in California and Florida and the ever-growing appreciation of the value of the fruit, which contains over 29 % of fat, make the Guatemalan and Mexican hard-shelled varieties of much interest, they ripen in spring and winter and have remarkable shipping qualities; they have of late years been grown in California; a Ceylonese mango, almost as large as a coconut, with a bright red colour and with almost no fibre; a *Feijoa Sellowiana* seedling, with an exceptionally large fruit; this species has proved exceedingly hardy in the south of the United States; 1 rosy-fleshed anona, called "ilama" (*Annona diversifolia*), one of the best of this class of fruit, and *A. purpurea*, with large aromatic fruit; 1 Chinese "wampi" (*Claucaena lansium*) which grows well in Florida and may be cultivated for its fruit; 1 variety of coconut rich in oil, from Punta Burica, Panama; 4 varieties of apples resistant to the woolly aphid (*Eriosoma lanigera*); *Pyrus betulaeifolia* sent by Dr. BRETSCHNEIDER to the Royal Botanical Gardens, Kew, and the Arnold Arboretum, Jamaica Plain, Massachusetts, it may be used as stock and could be useful in selection work; *P. Bretschneideri*, very valuable as an ornamental tree, and yielding yellow, round, juicy fruit; according to SARGENT the best Chinese pear trees are derived from this variety; *P. ovoidea*, which is probably the parent of the KIEFFER blight resistant pear, it has large, abundant flowers, and foliage that turns scarlet in autumn; *P. phaeoptera*, with pyriform fruit, which appears to be immune to blight (*Bactera amylovorus*), for a large tree in the Arnold Arboretum for many years has never contracted the disease although exposed to infection. This collection of Chinese pear trees, made by the Arnold Arboretum, will facilitate a comparative study of Chinese species (from which KIEFFER and E. CONTE obtained their blight resistant pears, by crossing and selection) and the determination of their value for grafting and selection purposes; wild apricot from the Shansi Province of China, where the natives pickle the kernels in brine and eat them as an appetiser; 2 small, sour, wild free-stone peaches from Sianfu, Shensi Province and Chaoyu, Shansi Province, China, respectively; *Prinsepia uniflora* from near Fucheng, Shansi, China, hardy, shrub, bearing dark red, juicy and sour fruit resembling cherries.

19 — The Separation of Autogenous and Added Hydrocyanic Acid from Certain Plant Tissues and its Disappearance during Maceration. — ALBERG, CARL L. and BLACK, ORIS F. (Office of Drug Plant, Poisonous Plant, Physiological and Fermentation Investigations, Bureau of Plant Industry, United States Department of Agriculture, Washington), in *The Journal of Biological Chemistry*, Vol. XXV, No. 1, pp. 133-140. Baltimore, Md., May, 1916.

In this paper it is shown that the leaves of *Prunus virginiana* must be

distilled with acid 4 hours before all of the hydrocyanic acid is liberated, whereas in *Andropogon* and *Panicularia* less than 1 hour is sufficient to liberate all hydrocyanic acid present. It is further shown that in macerating plant tissues that contain hydrocyanic acid a certain amount of the hydrocyanic acid present or of cyanide that may be added is so converted that it is not recoverable by distillation with sulphuric acid. This is not due to the action of enzymes or to the presence of glucose. It is thus shown that in determining hydrocyanic acid in plants several methods in corroboration of each other must be used.

630 - **The Direct Influence on the Stock of the Sap produced by the Scion, and the Action on the Plant of Acid Solutions Absorbed Directly: Experiments in Italy.** — CAMPBELL, C., in the *Atti della Reale Accademia dei Lincei*, Series V, *Rendiconti*, Vol. XXVIII, 1st. Half-Year, No. 1, pp. 57-61. Rome, January 6, 1918.

Plants that are wild or have become so are usually more resistant to parasites than cultivated plants; this has suggested the hypothesis to Prof. COMES that this difference in behaviour is due to the greater acidity of the sap of wild plants (1).

The author has tested Prof. COMES' hypothesis in two different ways: 1) by grafting a wild plant on a cultivated plant of the same genus (plum on peach or wild apple on an ungrafted apple) and studying the influence on the latter of the sap produced by the former; 2) by making the plant take up acid solutions through its aerial parts by the method of Prof. ACQUA (*Rendiconti della R. Accademia dei Lincei*, 1914).

ACTION OF THE SAP PRODUCED BY THE WILD SCION ON THE CULTIVATED STOCK. — If Prof. COMES' hypothesis is correct, the sap produced by the scion, being more acid, should increase the resistance of the stock to parasites. This was confirmed experimentally; in fact, after the 2nd and 3rd year of grafting, the influence of the scion on the stock is shown by the deeper colouring of the leaves of the cultivated plant (more marked in the peach) and its greater resistance both to drought and certain parasites in the peach, against *Exoascus deformans*; in the apple, against *Oidium farinosum*.

DIRECT ABSORPTION OF ACID SOLUTIONS BY THE AERIAL PARTS. — Up to the present, the author has studied 0.5, 1 and 2 ‰ solutions of tartaric, citric and malic acids in pure distilled water or plus a little saccharose to vary the osmotic pressure. By means of a cut branch immersed in water, an apple-tree heavily attacked by *Myzoxylus laniger* (= *Schizoneura lanigera*) and peach-trees heavily attacked by the aphid *Anuraphis persica* (= *Aphis persicae*) were made to absorb acid solutions at first in 1915; then in 1916 and 1917. In the spring of 1917, it was found that, as regards the apple-tree which had absorbed the acid solution, the *Myzoxylus laniger* had almost completely disappeared and that, in comparison with the controls, the upper leaves were better developed and of a deeper green. The infection, with the conidial form (*Oidium farinosum*) of *Podosphaera leucotricha*, with which all the other ungrafted plants were attacked, did not affect the plant in question or the wild plants. Of the 2 peach-trees mo

(1) See *B.*, 1913, No. 881; 1914, No. 978; *R.*, 1916, No. 937. (Ed.).

everely attacked by the aphids, the one that had absorbed the acid solutions (and which was in worse condition than the other at the beginning) has survived, while the one that was not treated died.

The author has the intention of continuing and enlarging these researches, and he considers it will be useful to try again the influence of an American vine-scion on a European stock, as regards resistance to phylloxera, to establish the value of the change taking place in the chemical conditions and to include the direct absorption of liquid in his experiments.

191 - **The Influence of Acids on Germination** (1). — MAQUENNE, L., and DEMOUSSEY, E., in the *Comptes Rendus des Séances de l'Académie des Sciences*, Vol. CLXVI, No. 14, pp. 547-552. Paris, April 8, 1918.

Up to the present there is no precise information available as to the influence of acids on germinating seeds. It is certain that they are injurious at concentrations of 1/1000, but nothing is known as to the minimum at which they begin to take effect. The latest work on this subject has been carried out by Mlle PROMSY (2) and M. MICHELS (3).

For their experiments the authors used peas and wheat, previously swollen by soaking in pure water for 24 hours. The experiments were carried out in two ways: — in saucers, in sand soaked with weak hydrochloric or sulphuric acid, and in quartz tubes filled with the same solutions 100 times more dilute.

CONCLUSIONS. — Mineral acids should be placed among the substances that are most injurious to germination. Their toxic action which, when the acid is free from other substances apparently cannot be changed to a favourable one, can be modified by the presence of electrolytes of salts.

In this, acids behave like all other mineral poisons: especially harmful when acting alone, they are sensitive to the influence of antitoxins amongst which calcium appears to be one of the most powerful. And, as with the salts of heavy metals, mineral acids sensibly diminish the efficacy of calcium sulphate.

192 - **Some Effects of Organic Growth-Promoting Substances (Auximones).** — I. BOTTOMLEY, W. B. (Professor of Botany, University of London), Some Effects of Auximones on the Growth of *Lemna minor* in Mineral Culture Solutions, in the *Proceedings of the Royal Society* (Biological Sciences), Series B, Vol. 80, No. B621, pp. 481-507 + 13 Tables + 7 Fig. + 2 Pl. London, 1917. — II. MOCKERIDGE F. A. (King's College, London), Some Effects of Auximones on the Soil Organisms concerned in the Nitrogen Cycle. *Ibid.*, pp. 508-533, + 15 Tables. 1917.

I. — In a previous communication (3) the author showed that bacterial peat (4) contains certain organic growth-producing substances which he calls "auximones" and which, when added in very small amounts to wheat seedlings growing in water culture, cause a marked increase in growth.

(1) See R., September 1917, No. 803. (Ed.) — (2) Thesis No. 1479 of the Science Faculty of the University of Paris. Marseilles, 1912. — *Bull. Acad. Royale de Belgique, Science Section*, 1913. 140 (104).

(3) See R., January 1917, No. 21. — (4) See B., 1914, No. 1102. (Ed.).

The author started fresh experiments with *Lemna minor*, a plant whose rapid growth can be easily noted. A number of comparative culture tests (control cultures in Detmer's culture solution — cultures in that solution plus small quantities of extracts of bacterised peat as : - a) aqueous extract ; b) alcoholic extract ; c) phosphotungstic acid fraction) have led to the following observations :—

1) The auximones contained in bacterised peat have an enormous influence on the growth of *Lemna*, even when added in small quantities; the plants grow in number and weight, the cells are larger, the protoplasm is denser, the nucleus larger and the chloroplasts are more numerous.

2) In *Lemna* normal growth and multiplication cannot be sustained for any length of time in the absence of auximones in an exclusively mineral solution ; auximones are essential for the effective utilisation and assimilation of the mineral substances supplied to these plants.

The addition to the mineral culture solution of 368 parts per million of organic matter from the water extract of bacterised peat resulted, after 6 weeks, in multiplication of the number to 20 times, and an increase in weight to 62 times, that of the control plants.

3) It is highly probable that these auximones are organic decomposition products, for bacterised peat is simply organic matter, already partly decomposed by anaerobic action, which has been further decomposed by the agency of aerobic bacteria under suitable conditions. Some of them may be absorbed and utilised directly as plant nutrients. SCHREINER and SKINNER have shown that such nitrogenous decomposition products as creatinine, histidine and arginine can replace nitrates in a culture solution, and that, even when nitrates are present, these substances are absorbed by the plants; these compounds are absorbed as such and utilised directly for building up the proteins and other complex nitrogenous constituents of vegetable material. They also suggest that the energy required for the transformation of inorganic nitrogen into an organic form being no longer required, it can be expended otherwise when these substances are supplied to the plant and results in more rapid growth and increased plant efficiency. Other auximones may have a similar effect to the accessory food bodies or growth vitamins concerned in animal growth, which would explain the enormous effect produced in comparison with the quantities present.

5) The great sensibility of the plant to the action of these substances is shown clearly when the quantity of auximones is progressively diminished or when the culture solutions are exchanged.

6) The fact that plants can grow in exclusively mineral solutions does not constitute an objection to the suggestion that the presence of organic substances is necessary, for BROWN has shown that nitrogenous organic growth-promoting substances may be produced in the endosperm during germination and absorbed by the embryo.

II. — The author has made different cultures of the organisms concerned in the nitrogen cycle (nitrogen-fixing, nitrifying, ammonifying and denitrifying bacteria), which were mixed with extracts of bacterised peat. The results of the researches indicate that : —

1) Soluble humus is a very important factor from the point of view of the activities of soil bacteria. Its effect on the organisms appears to be largely independent of any organic matter it may contain; it is shown to be due to the presence of auximones;

2) auximones increase the rate of nitrogen fixation and nitrification, depress the rate of denitrification, and do not appreciably affect the rate of ammonification.

If auximones play some definite part in the building up of the complex nitrogenous molecules of the organism, it follows that a directly opposite effect should be produced on the two classes of bacteria (nitrifying and denitrifying) whose activities are directed upon such widely divergent lines.

33 — **Translocation of Seed Protein Reserves in the Growing Maize Seedling.** — PETTIBONE, C. J. V. and KENNEDY, CORNELIA (Biochemical Laboratory, Department of Physiology of the Medical School, University of Minnesota, Minneapolis), in *The Journal of Biological Chemistry*, Vol. XXVI, No. 2, pp. 519-525, 2 Diagrams, Baltimore, Md., September, 1916.

In view of the establishment of the fact that in animals the proteins of the food enter the blood stream and are transported to the tissues at least in large measure in the form of amino-acids, the authors have judged of interest to settle the same problem in connection with the transference of reserve seed proteins in plants and have undertaken the study of the form in which the reserve proteins of the kernel are transported in the growing maize seedling. The conclusion arrived at from the results is given below:—

It is clear that amino-acids are present in the flowing sap of maize seedlings. Since these compounds are present at all times in seed, rootlet and plumule, their presence in the flowing sap coupled with the migration of nitrogen, indicates beyond question that the process of transportation of the reserve proteins of the seed, to furnish building material for the proteins of the growing parts, takes place in a manner analogous to the transportation of protein food supplies in the animal organism. The appearance of a slight cloudiness when the sap was mixed with alcohol, and the relatively slight increase in amino-acid nitrogen after hydrolysis suggest, however, that a portion of the nitrogen may be transported in the form of soluble protein or protein hydrolytic products of peptide type.

34 — **The Origin of "Humpback" Wheat by Selection.** — See No. 642 of this Review.

35 — **Two New Varieties of Field Pea Obtained by Pure Line Selection, in Norway.** — CHRISTIE, W., in *Aarsberetning an aarende de offentlige foranstaltninger til Landbrugets fremme i aaret 1916*, pp. 515-518. Christiania, 1917.

The field pea (*Pisum arvense*) cultivated in Hedemarken (Norway) consists of a mixture of forms that differ in their yield of seed and straw, in their earliness, and other characters.

The article under consideration gives the results of researches carried out with the idea of isolating the best of the different forms. Thus, in 1905 and 1906, a choice was made from 118 and 225 specimens (destined to serve as parents for the new lines) in the localities of Nordre Lund and Luttekvaern, province of Furnes. A series of comparative trials, with progressive elimination of unpromising types, gradually reduced the number

of lines to 2 only, which were worth considering as valuable new varieties. These were "Möistad gulgrönne ert" (Möistad yellow-green field pea) and "Möistad brandede ert" (Möistad mottled field pea), entered in the genealogical register as No. 0203 and No. 0402.

As regards the yield of the different varieties and the length of their growing period, the following data is available for the 4 year period 1909-1912:

YIELD IN SEED. — The mottled field pea 0402 (relative yield: 100) takes first place with an average of 2248 lb. per acre, i. e., 946 lb. more than the common Hedemarken field pea (relative yield: 83) and 242 lb. more than the yellow-green field pea 0203 (relative yield: 96), which only surpassed it in yield in 1911.

YIELD IN STRAW AND EARLINESS. — Both mottled and common field pea give practically the same yield in straw (3729 lb. and 3899 lb. respectively per acre) while the yellow-green field pea (3131 lb. per acre) gives a much inferior yield to both the others, probably on account of its earliness. In fact the length of the growing period is 109 days for the yellow-green field pea, 118 days for the mottled field pea, and 116 days for the common field pea. The more early a variety is, the smaller is the amount of green parts that it produces.

The following are the chief characters of the two new varieties: —

1) Möistad yellow-green field-pea No. 0203. — It is a form of *Pisum arvense* var. *unicolor* ("enslarvet graaert") which differs from the common Hedemarken field pea in greater earliness and bigger yield of seed, while it is slightly inferior as regards yield in straw. The seeds are round, small and of a fine yellow-green colour.

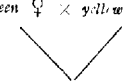
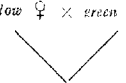


2) Möistad mottled field pea No. 0402. — It is a form of *Pisum arvense* var. *punctato-maculatum* ("prikket-marmoreret graaert") It is clearly superior to the common Hedemarken field pea for yield in seed while retaining this useful earliness and high yield in straw that characterises the common variety. The seeds are mottled with brown on a grey-green ground, thus giving it its name 'mottled' field pea.

636 - **Maternal Inheritance in the Soy Bean.** — TERAQ, H., in *The American Naturalist*, Vol. LII, No. 613, pp. 51-56. New York, January, 1918.

The cotyledons of the soy bean (*Glycine hispida* Maxim.) may be green or yellow. In the first case the seed-coat is always green, in the second it is either green or yellow. The results of the author's experiments since 1910, summarised below, show that these colours are transmitted by the maternal plant only.

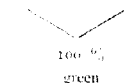
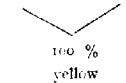


1) **TRANSMISSION OF THE COLOUR OF THE COTYLEDONS.** — Reciprocal crosses between varieties with yellow cotyledons and with green cotyledons give, in the F_1 , hybrids of the same character as the female parent. In F_2 this phenomenon is repeated without there being any Mendelian segregation of characters such as might be expected. Table I illustrates the results.

TABLE I. — *Transmission of the colour of the cotyledons.*

Parents	green ♀ × yellow ♂	yellow ♀ × green ♂
		
	Plants with green cotyl.	Plants with yellow cotyl.
	100 %	100 %
		
	Plants with green cotyl.	Plants with yellow cotyl.
	100 %	100 %

2) TRANSMISSION OF THE COLOUR OF THE SEED COAT. — This is more complicated. In the cross *Green* ♀ × *Yellow* ♂ (See Table II) the colour of the seed coat is transmitted exclusively by the female plant, as in the case of the cotyledons. The cross *Yellow* ♀ × *Green* ♂, however, gives in F_1 hybrids with yellow cotyledons and green seed coats, and in F_2 , $\frac{3}{4}$ of the individuals have green seed-coats and $\frac{1}{4}$ yellow seed coats according to the Mendelian ratio 3 : 1.

TABLE II. — *Transmission of the colour of the seed coat.*

Parents	Green ♀ × Yellow ♂	Yellow ♀ × Green ♂
Colour of cotyledon	green yellow	yellow green
Colour of seed-coat	green yellow	yellow green
		
F_1	100 %	100 %
Colour of cotyledon	green	yellow
Colour of seed-coat	green	green
		
F_2	100 %	25 % 50 % 25 %
Colour of cotyledon	green	yellow yellow yellow
Colour of seed-coat	green	green green yellow

EXPLANATION OF THESE PHENOMENA. — The behaviour of the chlorophyll of the aerial parts of the plants is identical with that of the cotyledons; when the plant ripens the leaves and stem of individuals with yellow cotyledons turn yellow, whereas, in plants with green cotyledons, the parts keep their green colour without changing for a longer period. There are, then, two types of chlorophyll: — *Y*, which can be changed to yellow and, *G* which remains green. Both of these characters probably have their seat in the cytoplasm of the egg-cell, and are, thus, transmitted directly by the female plant.

The action of the chlorophyll of the seed coat, however, which may be green even in plants with yellow cotyledons, is probably due to the presence of a factor *H*, which prevents *Y* from colouring the seed coat yellow so that it remains green even in the absence of *G*. The absence of the inhibitory factor *H* is expressed by *h*. In varieties with *G* chlorophyll the presence or absence of *H* is shown by the varying intensity of the green

These facts make possible an explanation of the phenomena described above. Thus the cross *green* ♀ × *yellow* ♂, with the formula (*G*) *HH* ♀ × (*Y*) *hh* ♂, gives in *F*₁ a hybrid (*G*) *Hh*, which is green, and, in *F*₂ three hybrids (*G*) *HH*, (*G*) *Hh*, (*G*) *hh*, all of which have green cotyledons and see coats (see Table III).

On the other hand, the cross *Yellow* ♀ × *Green* ♂, with the formula (*Y*) *hh* ♀ × (*G*) *HH* ♂, gives in *F*₁ individuals (*Y*) *Hh* with green seed coat and in *F*₂, 1/4 of the individuals (*Y*) *HH* green, 3/4 (*Y*) *Hh* green, and 1/4 *Y* yellow, as would be expected.

Table III shows the transmission of the characters "green" and "yellow". In each case *G* and *Y* are transmitted by the female plant only; thus, in the cross in the first column, the *F*₁ hybrid has the formula (*G*) *Hh* instead of *YGHh*. Similarly, in the cross in the second column the formula of the hybrid is (*Y*) *Hh* instead of *YGHh*. The factor *H*, however, is obviously contained in the nucleus and is also transmitted by the male plant, in accordance with the Mendelian law.

TABLE III. — Transmission of the characters "Green" and "Yellow"

Parents	(G) HH ♀	(Y) hh ♂	(Y) hh ♀	(G) HH ♂		
Colour of cotyledons	green	yellow	yellow	green		
Colour of seed coat	green	yellow	yellow	green		
<i>F</i> ₁	(G) Hh green green		(Y) Hh yellow yellow			
Colour of cotyledons	green		yellow			
Colour of seed coat	green		yellow			
<i>F</i> ₂	(G) HH	(G) Hh	(G) hh	(Y) HH	(Y) Hh	(Y) hh
	25 %	50 %	25 %	25 %	50 %	25 %
Colour of cotyledons	green	green	green	yellow	yellow	yellow
Colour of seed coat	green	green	green	green	green	yellow

CONCLUSIONS. — The colour of the cotyledons is transmitted by the female plant only, and is due to two determinants, *G* and *Y*, contained in the cytoplasm of the egg-cell, and each subjected to the action of a third determinant, *H*, contained both in the ovule and in the pollen grain, which has two effects on the seed coat : — 1) it modifies the intensity of the green colour, *G* : 2) it prevents plants containing *Y* from turning yellow.

The maternal inheritance described by the author seems to be identical with the character "*albo maculata*" studied by CORRENS in *Mirabilis jalapa* (1) and by BAUR in *Antirrhinum majus* (2), which is only transmitted by the female plant.

637 - **Hybridisation Experiments between Different Varieties of the Cultivated and Wild Strawberry, in Alaska, U. S. A.** — *Annual Reports of the Alaska Agricultural Experiment Station for the Years 1904-1915*, Washington, 1905-1916.

Numerous hybridisation experiments were carried out from 1904 to 1915 at the Agricultural Station of Sitka, Alaska, with a view to obtaining a new type of strawberry combining the following characters: —

1) Resistance to winter cold and the capacity to ripen fruit regularly during the cold, damp summer of the coastal district.

2) Firm, slightly juicy fruit.

Both these characters are found in the wild Alaskan strawberry, *Fragaria chiloensis*.

3) High yield.

4) Large fruit.

These two qualities are characteristic of the cultivated varieties.

ALASKAN WILD STRAWBERRY. — *Fragaria chiloensis* is plentiful along the coast from Icy Strait to Prince William Sound, in the most sterile sandy soils, to which it has adapted itself so well that, when transplanted into richer soils, it produces abundant vegetation but no fruit. The leaves of this species are characterised by having a large number of leaflets, 4 on an average, sometimes even 5 or 6. Flowering begins during the first 10 days of June, 2 or 3 weeks earlier than the cultivated varieties. The first fruits appear at the beginning of July and the plant continues to bear fruit until very late in autumn. The fruit is of average size, conical shape, very delicate flavour, with firm, slightly juicy flesh, very resistant to packing and transport.

CROSSINGS. — The female parents were the cultivated varieties Entrance, Magoon, Bismark and Hollis. The last named, which may be a native of Michigan, has not as yet been identified and has received the name of the place from which it came last — Hollis, in Prince of Wales Island, Alaska.

The cultivated varieties, kept in greenhouses, so that they should flower at the same time as the native species, were first castrated then fertilised with pollen from *Fragaria chiloensis*. The F_1 hybrids had the following characteristics: —

1) Vigorous, even excessive, growth.

2) Leaves similar to those of the native species, with 4 leaflets, but less well-developed blade, and longer and stronger petiole.

3) Fertility; resistance to unfavourable climatic conditions, but with very marked individual differences.

(1) CORRENS, C., *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, Vol. I, 1909, p. 291-329; Vol. II, 1909, pp. 331-340. — (2) BAUR, E., *Ibid.*, Vol. IV, 1910, pp. 81-102.
(Author).

4) Fruit as large as that of the parent Hollis, sometimes even larger, possessing at the same time the valuable characters of the native strawberry — firm, slightly juicy flesh, delicate flavour.

5) Shape of fruit varying from round to conical with all intermediate graduations; the pointed forms usually have a better flavour.

6) High productivity — more than 250 fruits per plant in the hybrids Nos. 1503, 537, 320.

The crossings, therefore, gave positive results, since it was possible to unite in one plant the valuable characters of both parents. The selection work is being continued with a view to isolating and fixing the most promising lines and thus create a good type of strawberry capable of being propagated throughout the coastal district of Alaska. It should be noted that the development of the blade and the size and number of the stomata make the new varieties absolutely incapable of resisting even a short drought and thus limit their being grown further south than a little beyond the 50° parallel.

638 — **Acclimatisation, Selection and Hybridisation Experiments with Fruit Trees in Alaska, U. S. A.** — *Annual Reports of the Alaska Agricultural Experiment Station for the Years 1904-1915.* Washington, 1905-1916.

The results are given of a series of acclimatisation, selection and hybridisation experiments, carried out from 1903 to 1915 at the Agricultural Station of Sitka, in order to obtain types of apple, plum and cherry trees capable of growing and bearing fruit in the coastal regions of south-east Alaska.

In the interior (Yukon Valley) experiments with arborescent Rosacea gave absolutely negative results from the beginning; the summer, though relatively warm, is too short for the wood and fruit to ripen, and the very severe winter never allows the plant to hibernate. Sitka is on the west coast of Barabanov Island in N. latitude 57° 3' and W. longitude 135° 20' (Greenwich meridian), and its climatic conditions are totally different from those which are suitable for the regular development of fruit trees. The summer-autumn period, from the last destructive spring frost to the first autumn frost, is fairly long (from May to September) but wet and cool, thus having an inhibitory influence on the ripening of fruit and wood. The winter, though less severe than in the interior, is nevertheless very cold and kills and, to a certain extent, causes necrosis of the buds which form during the favourable season. The absence of a hot and dry period prevents the plant from developing resistance to low temperatures by loss of water and thickening of the cell walls. The experiments dealt with varieties of apple, plum, and cherry trees.

I. APPLE TREES. — 1) *Acclimatisation.* The plants used in the acclimatisation experiments may be divided into three groups: — a) *Pyrus baccata*, a native Siberian variety; b) certain varieties known in North America as crab-apples, probably derived from a cross between *P. Malus* and *P. baccata*; c) different varieties of *Pyrus Malus* cultivated in the cold districts and known for their resistance to low temperatures.

Pyrus baccata, from Siberia and Manchuria, was first planted at Brandon, Manitoba, in 1890, and spread rapidly through the cold and wet districts of north-western Canada, where it thrives and bears fruit regularly every year. It is a fine tree with a thick crown, smooth bark, compact wood and tasty, reddish-yellow fruit, about the size of a cherry (diameter = 8 mm.) At Sitka it gave good results. Four times from 1908 to 1914 the fruit formed in good time, *i. e.*, before the first autumn frost; both the fruit and the wood ripen fairly rapidly.

Although few data on the subject are available the dates of the principal vegetative phases may nevertheless be stated approximately: — 1) Leafing during the first 10 days of June; 2) flowering during the last 10 days of June; 3) complete maturity towards mid-October. The first fruit was obtained in 1911 from trees 8 years old, planted at Sitka in 1903.

Pyrus baccata × *P. Malus*. — As has already been said the varieties of crab-apples are probably a cross between the two species *baccata* and *Malus* rather than products of a pure selection of *P. baccata*. These trees have already given very satisfactory results in different parts of Canada, and the experiments in Alaska justified the hopes placed in them. Only a few of the numerous varieties imported from time to time into Sitka responded to climatisation, but the greater part of those which succeeded belonged to the crab-apple varieties. They were Whitney, Transcendent, Martha, Ivan Sweet, Buir Sweet, Hyslop, Yellow Transparent, and Livland Raspberry. The two last hold first place. (The Report gives two photographs Whitney and Livland Raspberry apple trees, with their fruit).

Pyrus Malus. — The varieties Duchess, Peerless, Wealthy, Tetofski, Eschwick's Codlin and a few others are resistant to low temperatures and bear fruit, which, however, rarely ripens. In 1915 only, chiefly owing to the relatively warm September, all the above-mentioned varieties gave good yields, and the fruit ripened completely, but differed from fruit of warmer climates in its smaller size and longer, conical shape. Only summer varieties, ripening generally in the United States at the end of July or during the first 10 days of August, should be imported. None of the autumn varieties although resistant to cold, can ripen early enough, *i. e.*, during the first days of October at the latest. The approximate dates of the various phases of development are: *a*) growth of the wood-buds, towards mid-May; *b*) leafing during the first half of June; *c*) flowering during the second half of June; *d*) ripening during the first half of October; *e*) fall of leaves during the second half of October.

2) *Hybridisation*. — Along the Alaskan coast and near the sea, the native Alaskan Crab (*Pyrus rivularis* L.; a photograph of a branch is given) grows wild in dense thickets which are sometimes impassable. It rarely has a single stem, but usually a clump of shoots which branch out a few inches from their base and may reach a height of 18 to 22 feet, and a diameter of from 4 to 6 inches. The leaves are ovate-lanceolate with long petioles. The yellowish-red fruit, hardly bigger than a pea, looks like miniature apples, and has a very delicate taste and smell. It makes excellent jam. *Pyrus rivularis* flowers abundantly during the first days of June

(10 to 12 days earlier than the varieties under consideration) and ripens remarkably early, during the first days of October. As a rule the wood and new tissues attain a sufficient degree of ripeness and compactness each year to resist the winter cold.

The most important characters required are productivity, good quality fruit and resistance to adverse climatic conditions. An example of a satisfactory realisation of such factors is found in the wheat selected for southern Sweden. Crosses between the native varieties of Swedish wheat, early and resistant to cold, but with low yields, with the very productive, but late and slightly resistant English Squarehead varieties, gave hybrids uniting satisfactorily all the desired characters thus helping to increase considerably the grain yield of southern Sweden. Similarly it was thought that *Pyrus rivularis*, a native Alaskan apple, early and resistant, might be crossed with varieties of *P. Malus* with a view to increasing their resistance and also producing larger and better quality fruit.

So far the results of the experiments have been unsatisfactory. This is not surprising considering the bad state of preservation of the pollen used (collected in the United States from trees flowering 1 or 2 months before the Alaskan apple and sent by post). This difficulty has been overcome by using pollen from a resistant variety of *Pyrus Malus* flowering at Sitka almost at the same time as *P. rivularis*. The crosses were successful, but a large proportion of the fruit fell before fully ripe. A small quantity of seed obtained in 1914 was used, and positive results are hoped for eventually. It must be remembered that:— 1) certain varieties of *P. Malus* have succeeded, in favourable years, in ripening their fruit completely; 2) crosses with *P. baccata* have already produced very resistant types, with relatively large and well flavoured fruit. The greater part of the varieties crossed satisfactorily at Sitka and acclimatised there are crab-apples; 3) if, therefore, satisfactory results have been obtained with *P. baccata*, it is probable that *P. rivularis* when the hybridisation has succeeded, will give yet better results. The hard varieties of *P. Malus*, the Siberian crab-apple (*P. baccata*), the hybrids *Malus* × *baccata*, the Alaskan apple (*P. rivularis*) supply material rich in various characters, which, when suitably selected and combined, will probably lead to the formation of types specially adapted to the extreme northern districts.

II. PLUM TREES. — Numerous species and varieties of plum trees have been tested at the Sitka Experiment Station. Among them may be mentioned May Day, Tomahawk, Sayles, Wyant, Hawkeye, Forest Garden, I Lota, Rollingstone, Siont, Red June and Ait Kin, which flower during the first half of July, but do not bear fruit on account of the rain and damps which prevent setting. Varieties known for their resistance to cold obtained by HANSON in South Dakota for crossing with *Prunus Besseyi* Bailey, all gave absolutely negative results. In reality it is not the severe winter which prevents the growing of plums in south-west Alaska, but rather the heavy rains, absence of high summer temperature (see Table I), and the unfavourable weather conditions, which prevent the fruit from setting and the wood from ripening. The tissues which form in summer remain

fragile and without cohesion, and are destroyed every winter by temperatures which in other latitudes the plum could bear without suffering such serious damage.

In 1914 and 1915 a greengage produced ripe fruit in a garden at Sitka; the plant, however, had been grown on a trellis well protected from the wind. A hybrid from Koslov, obtained from the Botanical Garden of Chico, California, also promises well and good results are expected from varieties imported from northern Europe. Nevertheless, the results so far obtained must, on the whole, be considered as absolutely negative.

III. CHERRY TREE. — The varieties of sour cherry cultivated at Sitka flower profusely every year, but only a small proportion of the flowers (slightly more than 10 %) set. This is due to two causes: — 1) the summer rains and moisture which largely prevent normal setting; 2) the absence of pollinating insects. The little fruit which forms rarely ripens in good condition; rains and moisture crack the skin and cryptogamic diseases often attack the fruit and spoil it entirely. The 4 varieties, Early Richmond, English Morello, Ostheim and Dyehouse, planted in 1903, with the exception of the disadvantages already mentioned, stood the test well and began to bear fruit in the 5th year. The dates of the different stages of development are: — 1) leafing, first days of June; 2) flowering on an average towards the end of June or the first days of July, with great annual variations. Thus, in 1909, English Morello began to flower towards June 15, but in 1908 towards July 15. The same applies to the other 3 varieties. In very cold and damp seasons flowering is slow and may continue till August, but, in this case, the fruit does not ripen, as was the case in 1907. Setting occurs between the 10th and 20th day after the beginning of flowering, but, as has been said, it is rare; in 1906 only, under exceptionally favourable climatic conditions, the percentage of fertile flowers reached 40 %.

Ripening. — The English Morello and Dyehouse varieties usually ripen towards August 12, Ostheim towards the 10th, and Early Richmond (of which the Report gives a photo), the earliest variety, towards the 8th.

Duration of growing period and the various sub-periods. — a) between the fall of the leaves, which occurs about October 15, to the leafing of the following season, there is a period of about 7 ½ months; b) there are, on an average, 30 days between leafing and flowering; c) in spite of the low temperature and great moisture, there are barely 40 to 45 days between flowering and ripening. In this case the first place is again held by Early Richmond, with a real record for earliness, 1 month (1); in 1908, flowering July 15, ripening August 15; in 1906, flowering July 1, ripening August 1; d) there is usually a little more than 2 months between ripening and the fall of the leaves. In order to compare the effect of meteorological factors on growth, tables I and II reproduce the figures obtained at Sitka in 1906. Table I gives an idea of the peculiarities of the climate at Sitka during the formation and development of the fruit: — 1) heavy rains (July and August);

(1) In Italy an average of 71 days (AZZI, G., Climatology and Phytogeography, in *Rivista orico-agraria*, Year XXXVI, No. 33, p. 24. (Ed.)

2) relatively low average daily temperature (July; 10°C ., whereas at Rampart, in the interior, it was 12.19°). In spite of that the first ripe fruit was obtained on August 1, so that the total average daily temperature during the 3rd sub-period of growth (from flowering to ripening) is a little over 300°C . (306°C .) (1).

CONCLUSIONS. — 1) *Plum trees*, results almost completely negative; the fruit and wood ripen in exceptional cases only; 2) *Cherry trees*, certain cultivated varieties of sour cherry may, without any morphological changes, develop in the south-west of Alaska, limiting the duration of the 3rd sub-period to a minimum of one month, in spite of the damp and coolness of the coastal districts; 3) *Apple trees*, none of the cultivated varieties of *Pyrus malus* can be successfully imported, hybrids obtained from crosses with crab-apples give no regular annual crop, and only bear fruit every two years or more rarely. Nevertheless the wild Alaskan *P. rivularis* may be crossed with *P. malus*, and it is probable that, by a series of such crosses, the small fruit of the wild apple might be improved without decreasing the resistance which allows the tree to flower and bear fruit regularly each year. Alaska can certainly never become a fruit-producing country, but this in no way diminishes the great practical and scientific importance of these investigations, the results of which may be profitably applied in the high mountain and vast northern regions of America, Asia and Europe.

TABLE I. — *Meteorological data obtained at the Sitka Station, Alaska, during the period January-October, 1906.*

(These meteorological data should be compared with the data for the growth of the apple and plum trees given in the text).

	Temperature			Total rainfall in.	Number of days of				
	maximum	minimum	daily average		clear weather	uncertain weather	cloudy weather	rain or below	
January	48 °F	— °F	26.10 °F	7.25	11	1	19	1	
February	50	22	37.28	1.89	16	3	9	1	
March	55	21	39.03	1.58	17	3	11	1	
April	59	31	41.93	10.63	3	10	17	2	
May	75	31	47.82	3.46	7	11	13	1	
June	65	34	55.39	3.34	11	10	11	1	
July	69	40	54.91	7.45	9	1	19	1	
August	65	43	54.79	4.66	9	3	19	1	
September	66	33	52.35	5.78	6	4	20	2	
October	65	34	46.57	15.22	1	6	24	2	

(1) In Italy the total average was 921°C ., i. e., 3 times as large (Reference the same paper Note on p. 68-).

TABLE II. — *Data on the growth of varieties of cherry grown at Sitka in 1906.*

Variety	Leafing	Flowering	Setting	Ripening	Fall of leaves
English Morello. . .	May 20	July 1	20 %	August 10	October 14
Early Richmond . .	June 1	July 1	40 %	August 1	October 15
Stenheim	June 1	July 1	good	August 5	October 12
Dyehouse	June 1	July 1	good	August 5	October 12

39 - **The Germination and Purity of Seeds in Montana.** — ATKINSON, A., WHITLOCK, B. W. and JAHNKE, E. W. *University of Montana, Agricultural Experiment Station, Bulletin No. 113, Third Annual Report of the State Grain Laboratory of Montana*, pp. 79-100, Bozeman, Montana, December, 1916.

The work of the Montana State Grain Laboratory during the year 1915-1916 consisted of: — 1) Purity and germination tests of 5 035 samples received; 2) a study of the seed value of frosted wheat; 3) a continuation of the study, begun in 1915, of hard seeds in clover samples; 4) a study of the germination of seeds at different periods after harvesting; 5) cooperation with the Association of Official Seed Analysts of America in studies on the standardization of grain laboratory methods; 6) a continuation of milling and baking studies of Montana wheat.

The two outstanding features of the year's work were a great increase in the number of samples sent for testing, and the very marked increase in the weed-seed content of alfalfa, clover, timothy and sweet clover. There was a tendency for the impurities in seed samples to increase each year; for example, in 1913-14 the average percentage of impurities was 5.91, in 1914-15 it was 6.32, and in 1915-16 it rose to 8.3. The purity of alfalfa and clover was higher in 1915-16 than in the two preceding years, but was still considerably below the standard. There is no doubt that there is an increased percentage of bad weeds in all crops, and, unless great care is taken to insure the use of clean seed, this increase may become very serious.

Numerous tests were made of the average germination of the principal grains and grass seeds grown. Maize, oats, barley and flax, had a somewhat lower average germination for the year 1915-16 than for 1914-15, though the decrease was of importance in maize only, the average germination of which was below 80 %, thus again showing the importance of carefully testing seed maize. The average germination of alfalfa and clover was satisfactory, very little of the seed falling below the Government standard. Many vegetable seeds were also tested and, except in the case of parsnips and carrots, the average germination quality was generally high.

To determine the value of frosted grain for seed, comparative field tests were made of the germinating capacity of frosted and unfrosted seed. The results given in Table I showed that frosted grain has a slightly lower field germination, but gives a greater number of heads per row and a higher yield.

TABLE I.

Seed	Number of samples	Field germination (per cent.)	Average number of heads per row	Grain per row (grams)
Frosted	32	75	1525	1457
Unfrosted	32	78	1509	1375

These figures show that, though the seed value of grain may be entirely destroyed by frost, this is not necessarily the case, and that it is wise to have all such seed tested before discarding it.

A set of experiments was also made to test the germinating capacity of grain at different periods after threshing. The results, contained in Table II, show that wheat, oats and barley have a low germinating capacity immediately after threshing, but that this capacity increases with the duration of the period after threshing.

TABLE II.

	Winter wheat		Spring wheat	Oats	Barley
	1915	1916	1916	1915	1915
Number of tests	7	14	12	5	4
Germination 1 week after threshing	53 %	8 %	18 %	15 %	60 %
Germination 1 month after threshing	79 %	66 %	75 %	88 %	86 %
Germination 2 months after threshing	96 %	99 %	90 %	96 %	95 %

At the end of the bulletin is given a list of 21 of the worst weeds, together with illustrations and a short description of the seed and plant. It includes : —

Bull thistle (*Carduus lanceolatus*) ; Quack grass (*Agropyron repens*) ; Pigweed (*Amaranthus retroflexus*) ; Green foxtail (*Chaeochloa viridis*) ; Peppergrass (*Lepidium apetalum*) ; False fl. (*Camelina sativa*) ; Fanweed (*Thlaspi arvense*) ; Wild mustard (*Brassica arvensis*) ; Dandelion (*Cuscuta* spp.) ; Russian thistle (*Salsola pestifer*) ; Lamb's-quarters (*Chenopodium album*) probably the most common weed in Montana ; Wild oat (*Avena fatua*) ; Wild buckwheat (*Eriogonum convolvulus*), a great nuisance in grain fields ; Canada thistle (*Carduus arvensis*), very common and troublesome ; Curled dock (*Rumex crispus*) ; Shepherd's purse (*Capsella bursa-pastoris*) ; Cow cockle (*Vaccaria vaccaria*) ; Gumweed (*Grindelia squarrosa*) ; Sheep sorrel (*Rumex acetosella*) ; Wild sunflower (*Helianthus annuus*) ; Marsh elder (*Iva xanthifolia*).

640 — Study on Two Spring Wheats: "Aurora" and "Blé des Alliés". — PIEDALU, in the *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 1, pp. 369-372. Paris, March 20, 1918.

The author presents the results of his chemical and technical study of the two spring wheats "Aurora" and "blé des Alliés" as a supplement to

the communication made by M. JACQUES DE VILMORIN to the French Academy of Agriculture on December 5, 1917 (1).

Aurora wheat, which gives the very high yield of 3212 lb. per acre, can ripen in 3 months (May 1-July 31).

The "blé des Alliés" variety was sown on May 5 and harvested on September 5, yielding 1342 lb. per acre. It can be sown either in Autumn or in Spring, up to April 15. After the latter date it is rarely sown.

The chemical and technical tests confirm the results obtained by growing the wheat.

The weight per bushel is high: 65 lb. for the first and 63 lb. for the second.

The flour is excellent, with a good gluten-content. It bakes well, giving normal yield; 124 % in long fancy loaves, well cooked and ready for eating.

These two new, quick-growing varieties that allow of late sowing have all the qualities of the best wheats.

11 - **Marquis Wheat.** — I. CARLETON, R. B. and ALLEN, C. J., in *Farmers' Bulletin* 732, pp. 7 + 2 Fig. Washington, May 9, 1916. — II. SCHRIEBAUX, in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 10, pp. 351-354. Paris, March 13, 1918.

I. — Marquis wheat is a hybrid produced by Messrs. A. P. SAUNDERS and C. E. SAUNDERS at the central experimental farm of Ottawa, Canada. It is one of the progeny of a cross made about 1892 between an Indian wheat, Hard Red Calcutta, as the female parent and Canadian Red Fife. The different forms obtained from this cross were separated in 1903 at Ottawa, and one of them, selected between 1905 and 1907, was called Marquis. On account of its good milling qualities, this wheat was sent to Manitoba in 1906 to undergo cultivation tests. Its earliness enabled it to resist the rust that so ravaged that province in 1907. Soon it became one of the chief varieties grown in Manitoba and Saskatchewan. The yields obtained from this wheat at the agricultural experiment stations of these provinces for the 8 years 1907 to 1914 were from 13.5 to 38 % higher than those obtained from Red Fife.

Marquis wheat is a beardless spring wheat with hard straw and chaff and a red, hard grain. It has the appearance of the wheats belonging to the Fife group of the northern Great Plains States, and is therefore classified in that group. It is an early variety ripening 98 to 135 days after sowing, according to the district and year; its average growing period in the northern Great Plains is 115 days, so that it is 3 or 4 days earlier than the other Fife varieties.

Thanks to this earliness it is able to a certain extent to resist scorching dry years, rust in wet years, and early frosts which, in this northern district, sometimes overtake wheat at the period of ripening. These characters make it a very valuable wheat for Canada. As the season favourable to growth increases as one goes further south in the United States earliness comes of less advantage.

(1) See R., February 1918, No. 157, (F.L.)

Experiments with Marquis wheat have been carried out at the Experiment Stations of 13 States, from Iowa to Minnesota in the east to Oregon and California in the west. In this vast stretch of land the adaptation and value of the new variety vary with the local conditions. This part of the United States may be separated into four divisions according to the chief conditions of the districts; 1) the northern Prairie or sub-humid zone, 2) the northern Great Plains or semi-arid zone; 3) the western Basin and the Coast or arid zones, 4) the irrigated districts of the northern Rocky Mountain region and great Basin zone.

A. — VALUE IN THE SUB-HUMID ZONE. — Wherever possible winter wheat should be grown. Where spring wheat can be grown the Marquis variety may be recommended. The varieties of Fife, Bluestem, and Preston grown should not be hastily discarded; the Marquis should be compared with these spring wheats and the best one chosen.

B. — VALUE IN THE SEMI-ARID ZONE. — 1) The winter varieties are best wherever they can be grown in the north of the Great Plains districts, 2) durum wheats are better than any common spring wheats in this zone, 3) Marquis is better than any other variety of common spring wheat in some parts of this zone and equal to any throughout the district. Where spring wheat is grown and durum is not used Marquis is a safe variety to cultivate.

C. — VALUE IN THE ARID ZONES. — The dry lands of the States west of the Rocky Mountains are included in the arid zones. Marquis wheat is not to be recommended for this district.

D. — VALUE IN THE IRRIGATED ZONES. — Marquis wheat has not yet been largely grown in the irrigated valleys of the western States. According to the information available it has given good results in western South Dakota and in Montana. In Idaho and Nevada the soft white spring wheats such as Dicklow, Defiance, Palouse, Bluestem and Little Club all out yielded Marquis under irrigation.

MILLING VALUE. — Marquis is a first class wheat for flour making being at least equal to Fife and Bluestem in this respect.

II. — The results obtained with Manitoba wheat in France and North Africa have exceeded all expectations; it has proved to be a spring wheat suitable to all the districts of France, and in the south of this country, in Algeria and Morocco it seems capable of replacing winter wheat, Marquis wheat appears to have all the good qualities of this wheat without its defects.

Marquis wheat was studied by the author in the Paris district, at Gagnon, and by M. SÉBASTIAN in the south of France, in the Bouches-du-Rhône. The results confirmed those of M. DE VILMORIN (1). — Marquis wheat proved earlier and more productive than Manitoba wheat. In M. SÉBASTIAN's field it developed in 107 days, ripened 8 days before Manitoba and 12 days before Red Fife (the chief variety of the mixture of wheats forming Manitoba). It yielded 0.030 lb per square foot, whereas the two other varieties barely yielded 0.024 lb. per square foot.

(1) See *R.*, February 1918, No. 157. (*Ed.*)

- 42 - **The Origin, Characteristics, and Quality of Humpback Wheat.** — THOMAS, LEVI M. (Assistant in Charge of the United States Grain Standardization Laboratory at Fargo, N. Dak.), in *U. S. Department of Agriculture, Bulletin* No. 478, 4 pp. + 1 Plates. Washington, D. C., December 30, 1916.

Humpback wheat is a bearded spring wheat characterized by a velvet chaff. It is being grown in increasing extent in Minnesota and to a limited extent in the Dakotas. This wheat has found favour with the producers because of the large yields claimed for it, but it is generally discriminated against by the grain trade because of its alleged inferior milling qualities.

This strain of wheat is said to be the result of a field selection by J. P. BERGLUND, a farmer living near Kensington, Minn., who about 18 years ago found, growing in a field of Bluestem wheat, a plant distinguished from the rest of the field by bearded heads and a more vigorous growth. The seed from this plant was planted separately, and produced a strain of wheat known as Humpback, which wheat was first distributed among the Kensington farmers 11 or 12 years ago. It was originally called Bearded Bluestem, a name given to it by Mr. BERGLUND because it has the characteristic velvety chaff of Bluestem, but it soon earned the more popular name of Humpback, owing to the peculiar shape of the kernels, the dorsal side being characterised by a prominence immediately to the rear of the germ and a curved slope toward the brush, making the term Humpback quite descriptive. The term Marvel, and perhaps other names, has been applied to this variety by distributors of the seed. This wheat should not be confused with the so-called Velvet Chaff wheats of the Northwest, which are bearded spring wheats of the Red Fife type and have a smooth chaff.

Humpback wheat has a large berry, somewhat soft in texture, giving a high yield of flour. The weight per bushel of this wheat is higher than that of Bluestem wheat.

The flour from the samples of Humpback wheat was lower in baking strength and general quality than the flour from the other spring wheats which were tested.

Milling and baking tests of Humpback wheats gave the following average results: — yield of straight flour, 71.2 per cent; volume of loaf per 340 gm. of flour, 2145 cc.; absorption (water used per 100 gm. of flour), 49.8; colour of crumb (score), 95.1; crude protein ($N \times 5.7$): in flour, 13.76%; in wheat, 14.35%.

- 43 - **Plants Yielding Tannin, in India.** — See No. 699 of this *Review*.

- 44 - **Venezuelan Production of Balata.** — BRETT, H., in *Commerce Reports*, No. 272, pp. 698-699. Washington, D. C., 1917.

Balata, a gum similar to gutta-percha, is largely used in the manufacture of belting. It is obtained from the sap of *Mimusops globosa* Gärtn., a tree reaching 100 feet or more in height, which is widely distributed over eastern Venezuela and the Guianas. The latex is secreted between the bark and the wood of the tree; it contains nearly equal proportions of resin and gutta, the latter being identical with true gutta-percha.

The word "balata" is of Carib origin and is used by the natives of British, Dutch, and French Guiana as well as by those of Venezuela, but it is applied solely to the gum, the tree being known as the "purguo". On the coast between Puerto Cabello and Cape Codera the tree is called the "nisperillo".

The commercial exploitation of this tree in Venezuela began near Maturin, where by 1894 it had already been exterminated. Sap collecting was then begun near San Felix in the State of Bolivar and, as the tree became scarcer, the area of operations was extended eastward to the boundary of British Guiana and southward along the Orinoco and its tributaries to all accessible regions. In Venezuela the custom is to cut down the trees in order to obtain the sap, and the industry has thus been progressively destroying itself. A governmental commission estimates that in the last 10 years alone the 10 000 collectors have destroyed 36 000 000 "purguo" trees and that the direct loss to the nation from this cause amounts to more than half a billion dollars. In spite of the fact that in British and Dutch Guiana felling is prohibited and that regular production of latex is obtained by tappings that do not kill the trees, the merchants of Ciudad Bolivar have opposed any governmental prohibition of the cutting down of trees, arguing that in whatever manner the tree is cut it will die and that there is no better method of obtaining the latex than felling.

The "purguo" is of slow growth, the period required for a tree to reach the productive stage being more than 10 years and full development not being attained for 30 years or more. The fruits, being agreeable in taste, are nearly all eaten by wild animals, so that natural reproduction is slow. The trees usually grow at the foot of hills where the soil is fertile and moist but not waterlogged, always scattered among other species and never densely. Land on which there are 16 purguos to the acre is considered rich.

The balata harvest begins in May and ends in August, but in years of continuous rains work may be carried on at all times except when the tree is in flower, the sap being then so poor as not to be worth gathering. The collector leaves his camp at 5 a. m., fells the first tree he finds, and makes four cuts on each side of the fallen trunk, to each of which he attaches a tin receptacle to catch the flow of latex. Having worked two trees he returns to his camp about noon carrying the product of his toil in a bag waterproofed with the same sap. The contents of the bag are emptied into a large receptacle. On Saturday all the collection of the entire week is coagulated by cooking, and afterwards the gum is pressed in wooden moulds into slabs weighing from 50 to 100 lb.

Under present methods the average production per tree is 3 gallons of latex, producing 18 lb. of balata worth from 15 to 40 cents a pound. By tapping properly it is estimated that each tree would produce latex worth \$2 each year for 30 years or more.

For a number of years balata, ranking immediately after coffee and cocoa, was third in importance among Venezuelan exports. The amount

and value of the shipments (stated in metric tons of 2 204.6 pounds and in American currency) from 1905 to 1916 were: —

Year	Tons	\$	Year	Tons	\$
1905	1 461	755 400	1911	2 222	2 449 070
1906	1 280	863 830	1912	1 698	1 767 260
1907	1 545	1 128 595	1913	2 219	2 032 870
1908	1 465	1 149 600	1914	894	698 625
1909	1 650	1 283 575	1915* . . .	1 069	789 325
1910	1 903	2 103 800	1916* (six months)	287	225 215

(*) According to *Documentary Leaflets of the International Institute of Agriculture*, April 1918, the exports for 1915 and 1916 were 1027 and 623 metric tons respectively (Ed.)

The war has caused great changes in the course of the trade in Venezuelan balata. During 1913 Germany led among the buyers of the gum on the Ciudad Bolivar market, France ranked second, the United States third, and Great Britain fourth. In 1914 the United States rose to first place, followed by France, Germany and Great Britain in the order named. In 1915 Great Britain occupied first place, the United States was second, and France was a poor third, Germany disappearing from the list. In January-June, 1916, Great Britain and the United States again ranked first and second, respectively and France and Germany were both missing from the list.

In 1906 the price of balata in Ciudad Bolivar reached the then high mark of 35 cents a lb.; the average price is between 14 and 21 cents. The best price in 1915 was 23.7 cents, but the latest official tariff of exportable products issued by the Ciudad Bolivar custom house fixed the official valuation of balata at 5 bolivares per kilo, or 43.8 cents per lb.

145 - **The Nature of the Soil and Manuring as Factors Determining the Tendency of Beets to Bolt (Set Seed) the First Year** (1). — MENERATI, O. and ZAPPAROLI, T. V., in *Le Stazioni sperimentali agrarie italiane*, Vol. LI, Pt. 1-2, pp. 24-40 + 2 Diagrams + 2 Pl. Modena, 1918 (Authors' summary).

The observations and researches of various experimenters (PRASKOETZ, HERZOG, HOLRRUNG, DEUTSCH, MONTEMARTINI) had already shown that the tendency of the beet to become annual is favoured by special external conditions, particularly by heavy applications of manures, especially organic ones, but no information was available derived from careful and systematic work. At the R. Stazione Sperimentale di Bieticoltura (Royal Beet-growing Station) the authors, after some preliminary work carried out between 1912-1914 (which shows that the phenomenon of "bolting" is certainly favoured by external conditions which place the plants in a condition to benefit from a copious supply of food material), started more rigorous and far-reaching experiments in 1916, both in the field and in boxes (DEHÉRAIN type), by varying the kind of soil and using, as well as various fertilisers, exaggerated quantities of farmyard manure, in order to reproduce the case, fairly common in practice, of badly spread farmyard manure or of heaps washed for a long period by the rain.

(1) See also *R.*, May 1917, No. 127. (Ed.)

Sowing was carried out about a month before the usual time when the stoppages of growth take place that more or less usually cause the beet to bolt. Germination took place simultaneously in both manured plots and boxes and in those that received no fertiliser, but in the former, growth was naturally much better. Below are given the percentages of plants obtained:—

	Percentages of annual plants			
	Without manuring	With manure		
		Complete mineral	Organic	Complete organic and mineral
Plots of medium soil (naturally fertile). . .	23	50	51	55
Boxes with sandy soil.	1-2	15	25	29
Boxes with medium soil (naturally fertile). . .	11-15	24	48	49
Boxes with organic soil (peaty).	28-34	41	44	41

CONCLUSIONS :— 1) It is clearly shown that the nature of the soil and manuring influences the bolting of beets.

2) The soil has an influence all the more as its fertility and richness in organic matter are greater.

3) The manuring, whether chemical or chemical plus organic, caused a considerable increase in the percentage of annual plants.

4) With the same seed sown at the same time, the extremes in the number of plants that bolted varied from 1-2 % in sandy, unmanured soil to 55 % in fertile, heavily-manured soil.

5) It is impossible to say whether the increase in soil temperature caused by a heavy dressing of farmyard manure, independently of the food material it contains, has any influence; in any case, the number of plants that set seed was considerable even in those plots and boxes that had only received a dressing of mineral manure.

6) It cannot be stated whether the organic, chemical, or mixed manuring causes an increase in the number of annual plants on account of the finer growth of the plants in the beginning, as the same tendency was shown even by weakly plants.

7) These observations confirm the necessity of considering *Beta vulgaris* as a facultative biennial and annual form (DE VRIES). It appears inexact to consider the setting of seed by the beet during the first year as a phenomenon of atavism.

646 - Experiments on the Cultivation of Sugar Beet in Sicily. — BORZI, A., in *Bollettino di Studi ed Informazioni del R. Giardino coloniale di Palermo*, Vol. IV, Pt. 1-2, pp. 107-114, Palermo, 1917.

Sugar beets were first grown experimentally over 1105 square yards of the Colonial Garden, and then by farmers who were supplied with seed from the Garden. The following varieties were tested: — Rich French white sugar variety (Fouquier d'Hérouel); improved white sugar, original selection A.; improved white sugar, original selection B.; Klein-Wanzleben. Sow

[645-646]

g was carried out in mid-January, and harvesting at the end of June. The Colonial Garden a harvest equal to 14.33 tons per acre was obtained. The average percentage of sugar was 12.7, with a minimum of 11.45 and a maximum of 14.10. Taken as a whole the results showed that conditions favourable to growth may be obtained if the date of sowing is advanced about 3 months so that the critical period during which the crop demands a maximum amount of water includes a good part of the winter and spring, and the vegetative period continues till the beginning of summer, when heat has an accelerating influence. By this means the economic utilisation of water is rendered possible in Sicily as a rotation crop where cereals are grown.

1 - **Varieties of Strawberry (1) and Their Culture in Indiana, U. S. A.** — OSKAMP, J., under the direction of WOODBURY, C. G., in *Purdue University Agricultural Experiment Station*, Vol. XX, *Bulletin* No. 200, pp. 16 + 14 Figs., Indiana, July, 1917.

Using as basis the observations made on the trials carried out at the Lafayette Agricultural Experiment Station (Indiana), 32 comparatively new varieties of strawberry are described, brief mention being made of 16 which, amongst those previously described (*Bulletin* No. 154, *Purdue University Agricultural Experiment Station*), are most popular in Indiana. The author indicates the self-fertile flowers and the pistillate or imperfect blossoms. In planting pistillate sorts, a staminate flower should be set every four rows to ensure proper pollination. Forty-two of the varieties are midseason; Americus; Dewdrop; Pan American; Progressive; Superb; Productive; autumnal; among them only the last one requires cross fertilisation; the mid-season varieties, 33 (Baldwin's Pride; Baltimore; Barrymore; Cascade; Class A; Early Jersey Giant; Early Market; Early Ozack; Evening Star; Fuller; Gandy; Grand Marie; Helen Davis; Hub; Indiana; Johnson; Late Jersey Giant; Lea; Manhattan; Missionary; Ohio; Orem; Pearl; Posey; Rewastico; Senator Dunlap; Sons Prolific; St. Louis; Twilley; Warren; William Bell; Winner) are self-fertile; 19 (Anna; Bauer; Class B; Columbia; Haverland; Knaub No. 1;aub No. 6; Sample; Warfield) require cross fertilisation.

For each of the 32 comparatively new varieties, the name of the person from whom supplying the original plants is given.

- **Varieties and Cultivation of Raspberries, Blackberries, Gooseberries and Currants in Indiana, U. S. A.** — OSKAMP, J., under the direction of WOODBURY, C. G. I. Varieties of blackberries and raspberries with notes on their care, *Purdue University, Agricultural Experiment Station, Bulletin* No. 201, Vol. XX, pp. 12 + 6 Figs. Lafayette, Ind., August, 1917. — II Gooseberries and currants, *Ibid.*, *Bulletin* No. 207, Vol. XX, pp. 11 + 10 Figs. Lafayette, August, 1917.

The author, taking as basis observations made during five years' experimental work at the Agricultural Station of Purdue University, Lafayette, describes 24 varieties of *blackberries*, the best of which are Agawam, Ancient One, Eldorado, Stones Hardy, Taylor; 9 varieties of *black raspberries*,

1) As regards strawberry selection and variety tests see R. 1916, Nos. 408 and 748; 1917, Nos. 18, 322 and 637. (Ed.)

among which may be recommended Cumberland, Kansas, New Stone Fort Plum Farmer; 15 varieties of *red raspberries*, the best of which are Cuthbert, Early King (King), Loudon; 17 varieties of *gooseberries*, specially recommending Downing, Houghton, Josselyn (American Red Jacket), Oregon Champion, Pearl; 14 varieties of *currants*, with special mention of North Star, Red Cross, Red Dutch, Wilder.

For each plant is given a short note on the method of cultivation and pruning, its enemies, diseases and methods of controlling them.

649 - **The Common Honey Bee as an Agent in Plum Pollination.**—HENDRICKSON, A. H. in the *College of Agriculture, Agricultural Experiment Station, University of California Bulletin* No. 274, pp. 127-232, 2 Figs. Berkeley, December, 1916.

The experiments described, carried out in the Santa Clara Valley forms part of a series undertaken to determine why, under certain conditions, some plums bear abundant crops and under other conditions bear light crops or none at all.

In a large orchard two pairs of adjacent French and Imperial plum trees, as nearly as possible of the same age and size, were enclosed in a tent of white mosquito net, so as to exclude all insects. In every other way the trees were under the same conditions as the other trees in the orchard. The tents were put up before any of the blossoms opened, and taken down when there was no longer any danger of outside pollination. As soon as 25% of the blossoms had opened a hive of bees was placed under one tent, and kept there throughout the blossoming period (about 5 days.) The bee seemed to prefer the flowers of the French plum to those of the Imperial plum. The results are given in the following table.

Trees	No. of blossoms counted.	No. of fruits matured.	Percentage
	April 11, 1916	August 1, 1916	
French plum under tent with bees	1 069	193	18.05
French plum under tent from which bees were excluded	1 058	11	1.94
French plums, average orchard set	9 991	359	3.59
Imperial plum under tent with bees	1 060	18	1.89
Imperial plum under tent from which bees were excluded.	1 050	0	0
Imperial plum, average orchard set. . . .	2 180	157	7.20

It is seen that the French plum under the tent with the bees set a much higher percentage of fruit than the other trees. The light crop obtained from the Imperial plum under the tent with the bees is unaccounted for and it is intended to carry out further experiments to determine the cause.

The results show the honey bee to be one of the most important factors in carrying pollen from one tree to another. The most satisfactory method of introducing bees into orchards has not yet been decided, but it seems as if the best results would be obtained by placing about one hive to

2 were during the blossoming period, after which the hives could be moved.

D - **The Selection and Acclimatisation of Fruit Trees in Alaska, U. S. A.** — See No. 638 of this Review.

1 - **Grafting Stock in Sicily: the Experimental and Demonstration Vineyards Attached to the Royal Nursery of American Vines at Marsala.** — PAULSEN, F. and MAGGIORI, N. in *Relazione sull'andamento del R. Vivaio di Viti Americane di Palermo*, pp. 42 + 5 Tables + 1 Map. Palermo, 1916. Abstract in *Le Progrès agricole et viticole*, Year XXXIV, No. 48, pp. 537-454. Montpellier, December 2, 1917.

The authors give the results of observations on grafting stock made by them in Sicily from 1907 to 1912. The hybrids obtained in the Palermo nursery were kept under observation for some time in the Luparello vineyard for parent plants and in the Rocazzo experimental vineyard, in deep, rather heavy loam, free from lime, and much infected by phylloxera. The hybrids which showed the best qualities were propagated and transferred to the experimental vineyards of the Marsala district (Vineyard of Casa Bianca, Spagnola, and Misilla) in order to study their resistance to lime and drought, their affinity for the various local stocks, some of which are the same as those of the province of Palermo, and their productivity as compared with that of these stocks. The authors' observations are not only of interest to vine-growers in Sicily, but also to those in Algeria and other countries.

The resistance to chlorosis of the stock imported from France into Sicily greater there than in their native country or Upper Italy. This is due to the very different climatic conditions, and chiefly to the difference in the distribution of rain in the southern and northern countries. In the northern countries rain usually falls during the period of vegetative growth, whereas in Sicily it falls during the winter rest, so that much less calcium carbonate is absorbed. Tolerance to this substance may also vary very greatly, by 20, 30 or 40 %. This influence of climate and the seasons is still more emphasised by the fact that rain water, unlike telluric water, always contains some carbonic acid which acts as a solvent on the calcium carbonate, thus greatly facilitating its absorption, and consequently, increasing its harmfulness.

According to the authors the high resistance of some vines to chlorosis depends on a selective faculty possessed within certain limits by the absorbing roots, which special environmental conditions, such as those mentioned above, can only decrease or increase.

Resistance to chlorosis is usually less in American vines than in native vines and their hybrids, and depends on the extent of the secretion of acid substances; those species and varieties with most acidity in the roots are least resistant to chlorosis and vice versa.

Moreover, this character is connected with the presence in the soil of certain substances such as iron and, it would appear, magnesia, which neutralise the injurious action of the calcium carbonate and are necessary to the formation of chlorophyll.

As regards *adaptation*, the authors noticed that certain Franco-American hybrids (Aramon \times Rupestris G. No. 1, and Mourvèdre \times Rupestris 1202) were subjected by the changes in environment to marked variations from the characters observed in France. Especially have they shown a rather low resistance to drought, by reason of a climate much warmer than that of their native country, particularly when grafted on plants such as Cataratto, Catanesc, etc., which are not very drought resistant. They, therefore, require moist, deep, fertile, not over heavy soils, otherwise there is danger of their fading or dying after a few years.

These conditions are particularly indispensable to Aramon \times Rupestris G. No. 1, the more so because it is a very productive stock.

Berlandieri R. Nos. 1 and 2, and their hybrids 420 A, 157-11, 34 E. M., 17-37, 319 A., 301 A., 301 B. and 41 B. usually do very well whether grafted or ungrafted, and are very tolerant to lime, even when it is present in a very assimilable form, as in the Spagnola experiment field, more especially so considering the wetness of the soil. Those which proved most resistant to drought under the conditions considered were Berlandieri Nos. 1 and 2, 157-11, 34 E. M., 301 A. and B. and 41 B. Nos. 420 A., 17-37 and 219 A. showed weak growth, especially when grafted on Cataratto, whether in the Casa Bianca experiment field, in calcareous sandy loam, ferruginous, light, stony, shallow, but with a permeable sub-soil, in the demonstration vineyard of Casa Bianca, or that of Misilla, in soil not very different.

The most productive stock are, in decreasing order, Aramon \times Rupestris G. No. 1, Berlandieri R. Nos. 1 and 2, 34 E. M. and 41 B. Those which showed greatest uniformity in this respect were Berlandieri Nos. 1 and 2, 41 B, 34 E. M., and 157-11. Production with the different stocks was usually more uniform in dry than in wet years.

The *affinity* of all these stocks for the native vines usually proved excellent. Only in rare cases did the plants die through lack of affinity, as happened with Mourvèdre \times Rupestris and 420 A. grafted with Catanesc in the Casa Bianca experiment field, but everywhere else its condition was normal.

Affinity does not depend only on the nature of the stock and the scion, or on their specific differences, but also on their individual differences and the functions they are called upon to fulfill as stock or scion.

To counteract fading due to lack of affinity it suffices to use a stock which is a good conductor and has strong tap roots. This removes, or at least greatly decreases the obstacle arising from pressure at the point of grafting, which if not the actual cause of the phenomenon, hinders at any rate the material exchange and the circulation of sap between the stock and the scion. As a rule it is best to use stock the functional capacities of which are superior to those of the scion, or to use as scion a native variety with limited requirements, the development and production of which are not excessive (e. g. Grillo), so that even if the symptoms characteristic of want of affinity do not disappear completely, they at least become much less serious and frequent than is usually the case.

There are marked differences in development and production according to the native varieties grafted.

Aramon \times Rupestris G. No. 1, for example, is killed by serious phylloxera lesions when grafted with Cataratto, but continues in very good condition with Pignatello, Damascino, Grillo and Grecanico, in the same soil. This fact had been remarked previously and was confirmed at Misilla and Casa Bianca. Aramon \times Rupestris G. No. 9, however, shows no sign of fading under identical soil conditions, and is in an excellent state of vegetation in the experimental vineyards. The same may be said of No. 2, and these two stock may be compared with Rupestris du Lot.

Very serious wilting due to *bramble-leaf disease* occurred in the Spagnola vineyard on plants of Aramon \times Rupestris grafted with Pignatello (a variety very subject to the disease), and on those of Mourvèdre \times Rupestris grafted on to Catanese (also very subject) from the first year after planting. The cuttings, however, came from a suspected locality. Only material known to be free from disease should be used.

One of the most brilliant results of grafting is that *it has made it possible to grow outside their zone of adaptation certain vines which in the past required special conditions*. Thus, Catanese, which ungrafted only does well in moist deep soils, when grafted with Sicilian-American hybrids of the Casa Bianca vineyards, proved strong and productive, even in dry, stony shallow soil.

The growth and yield of Zibibbo and Pignatello in the Misilla and Casa Bianca vineyards are very different from when they were ungrafted under similar conditions.

Mourvèdre \times Rupestris, which in its natural state suffers much from drought, grafted with Grillo has a very fine vegetation, even in the dry soil of the Casa Bianca experiment field.

Finally, the really exceptional fertility of certain scions which have attained a productivity hitherto unknown in these soils must be noted. Among these should be mentioned Damascino on Aramon \times Rupestris G. No. 1 in the Casa Bianca and Misilla vineyards, Cataratto and Grillo on Berlandieri \times Röss Nos. 1 and 2, in the Misilla and Spagnola vineyards, Periconne, Catanese and Grillo on 157-11 and 34 E. M., in the Misilla and Spagnola vineyards, and Cataratto, Pignatello and Grillo on 41 B. in the Casa Bianca and Spagnola vineyards.

This leads to other, more important considerations. It is known that in dry soils vines are very subject to great irregularities in yield because they respond more to the atmospheric variations of different years. In the case of well-chosen American vines, however, this occurs more rarely and to a slighter degree, because certain stock counteract the failings of the soil so as to make it comparable to moist soils of similar composition. It is, therefore, a great advantage of grafting and the new methods of vine cultivation that they have removed, at least to a great extent, the dangers arising from a crisis due to an excess or a failure in yield.

The system which has given the best results is that of cleft grafting, on account of the greater uniformity of development and the higher yield

(as average per stock and per surface unit) obtained. This is very marked when comparison is made between two demonstration vines at Casa Bianca, one of which had been cleft-grafted, and the other grafted in the vineyard. The same result is observed in the experiment field at Spagnola, where the rows planted with cleft-grafts were much more uniform and productive, and, in some cases (31 B. and Berlandieri Ress. No. 2) earlier, than those which were grafted in the vineyard.

English grafting in the vineyard is, moreover, insufficient to obtain uniform and regular rows without gaps. This makes it necessary to adopt other auxiliary systems of grafting, such as the English herbaceous graft and the flute graft, with which good results may be obtained by grafting in the vineyard, results which in many cases are not inferior to those obtained by cleft-grafting.

Among the hybrids obtained in Sicily and planted in the experimental vineyard of Casa Bianca, there are some which are really *remarkable and well worth propagating*, by reason of their vigour, their resistance to drought and lime, their affinity to the French vines, and their yield. Tests have shown the most satisfactory to be Paulsen Nos. 473, 509, 779, 1043, 1064, 1077, 1103, 1119, 1120, 1254, 1321, 1323, 1362, 1381, 1437, 1447, 1548, 1583, 1837, 1901, 1902, and Ruggeri Nos. 48, 70, 77, 110, 128, 140, 143, 152, 162, 180, 198, 252, 253, 298, 300.

The greatest affinity was found among the Paulsen hybrids, Sicilian-American or $\frac{3}{4}$ American, all of which are excellent from this point of view with the exception of a few in which the authors noted cases of "folletage" (apoplexy).

The Ruggeri hybrids, nearly all Americo-Americans have not, as a rule, given good results with Catanese, a plant already known for its slight affinity for American vines and their hybrids. This seems to support the hypothesis that Vinifera hybrids have a greater affinity for French vine than pure American ones.

On the other hand there are among the old Franco-American stock many examples which prove the contrary. Thus Mourvèdre \times Rupestris 1202, Colombeau \times Rupestris (Gamay Condere), Bourrisquon \times Rupestris Aramon \times Rupestris-G. No. 2 and No. 9, to mention only the principal ones and a large number of direct hybrid bearers, have often shown a lesser affinity for French vines than many Americo-Americans. Also Grimaldi 18 (Calabrese \times Rupestris), when grafted with Catanese, dies in the third or fourth year. Other Sicilian \times American hybrids which, during the first years after grafting appeared very strong, suddenly died after from "folletage" in the Casa Bianca experimental vineyard. Death by "folletage" is but a particular case of lack of affinity.

The hypothesis laid down after a study of "folletage" in Franco (according to which the disease is caused by the action of strong dry winds over a prolonged period thus causing excessive transpiration by the leaves as compared with the amount of water absorbed by the soil) is in no way justified. The authors' observations show that the hybrid obtained and selected in Sicily usually have a greater affinity to Sicilia

vines than have the old stocks, besides being extremely resistant to drought. This is very promising for vine-growing in this district, for which, in view of its almost tropical climate, the investigations described are of the greatest importance.

It is still necessary to select these vines further for resistance to bramble-leaf disease, in order to choose stock possessing to a high degree the quality of adapting themselves to local conditions as well as all the other characteristic good qualities, so that the vines may become continually more profitable. In other words, it is necessary to choose the stock which is most satisfactory in all respects and will prove most valuable to Sicilian vinegrowers.

652 - **Humification and Nitrification in Forest Soils.** - See No. 624 of this Review.

LIVE STOCK AND BREEDING.

353 - **Studies in Forage Poisoning** (1). - GRAHAM, R.; BRUECKNER, A. L. and PONTIUS, R. L. I. - A Preliminary Report on an Anaerobic Bacillus of Etiologic Significance. *University of Kentucky, Agricultural Experiment Station, Bulletin No. 207*, pp. 49-113. 36 Figs. II. - An Anaerobic Organism Isolated from Ensilage of Etiologic Significance. *Ibid.*, *Bulletin No. 208*, pp. 117-133, 7 Figs. Lexington, Ky., June and July, 1917.

I. - Forage poisoning has long been known in the United States, where it has caused serious loss in cattle, but more particularly in horses and mules. Previous experiments have already proved that *B. botulinus*, which causes botulism or meat poisoning in man, is pathogenic to horses and donkeys, producing symptoms closely resembling those of forage poisoning. The authors were able to confirm these results by experiments with horses and mules. In very acute cases the animals died without showing any previous symptoms, but, as a rule, the characteristics of the disease were loss of appetite, stupor, rapid breathing, subnormal or normal temperature, paralysis of the tongue and pharynx, salivation, slight watery discharge from nostrils, difficulty in feeding, muscular weakness, obstinate constipation, incoordination in walking, decumbency, decubitic ulcers accompanied by secondary infection, rapid horizontal movement of the fore feet as in running, intervals of coma until death. The incubation period may last from a few hours to a few days. Guinea-pigs are also very susceptible to infection by *B. botulinus*. Chickens are highly resistant, but it is interesting to note that the faeces of chickens fed *B. botulinus* are capable of infecting horses and mules given food contaminated with these faeces. This shows that bowls may be a factor in spreading the disease.

In order to study this question more fully further experiments were made with oat hay which had caused an outbreak of forage poisoning in 1915. The pathogenic factor in this hay proved to be water-soluble, and, after the forage had been stored for 22 months, fatally infected a horse which was given water in which it had been immersed. From the caecum of the

(1) See also R. November, 1917, No. 1032. (Ed.)

horse was isolated an anaerobic organism which was slightly motile, spore-forming, Gram positive and easily stained with the ordinary aniline dyes; the bacilli were single, but may occur in short chains. In its morphological characters this organism closely resembled *B. botulinus*.

The bacillus isolated from the caecum of the horse, when administered by the mouth, proved fatal to horses, mules, and guinea-pigs, causing symptoms indistinguishable from those caused by *B. botulinus*.

A thorough examination of the oat hay water in question led to the isolation of an organism which resembled closely that isolated from the caecum of the fatally infected horse; this organism, when administered by the mouth, caused death in horses, mules, and guinea-pigs, accompanied by symptoms identical with those caused by *B. botulinus*.

Antitoxic goat, sheep and cow sera, prepared against *B. botulinus*, proved efficacious against lethal amounts of a homologous toxin. The antitoxic serum afforded protection in horses when administered subcutaneously and intravenously, and in guinea pigs when administered intraperitoneally, against: 1) a fatal amount of homologous toxin by the mouth; 2) infection by the mouth with a lethal amount of the organism isolated from the caecum of the horse and against lethal amounts of the broth culture filtrate of this organism; 3) the bacilli isolated from the oat hay water.

The whole series of experiments seems to prove that *B. botulinus*, which is known to be capable of developing in forage, is the pathogenic agent in forage poisoning.

II. — Further experiments carried out on a farm, where there had been a natural outbreak of forage poisoning among mules, confirmed the results previously obtained. Agglutination tests with serum highly immune to *B. botulinus* and the organism isolated from the ensilage which caused the outbreak were positive, but normal sera of different animals agglutinated neither of the organisms. Sheep and horse sera immune to the organism isolated from the ensilage gave positive agglutination results with *B. botulinus* and the pathogenic organism isolated from the horse which died as a result of drinking water from infected oat hay.

654 — **The Toxic Action of *Thlaspi alliaceum* and the Active Principles of Some Poisonous or Suspected Cruciferae.** — BEGUINOT, AUGUSTO, in *Atti dell'Accademia Veneto-Trentino-Istriana*, Vol. X, pp. 99-110. Padua, 1917.

In May, 1917, the author (Director of the Royal Garden of the Botanical Institute of Padua) examined some fresh fodder cut at Pettorazza (province of Rovigo). It had been asked whether such fodder could have caused the death of oxen (8 out of about 40 which had shown signs of poisoning) on a farm at Pettorazza. The author noted that the fodder consisted largely of the Crucifer *Thlaspi alliaceum* L., in an advanced stage of fructification, most of the seed being ripe.

Cruciferae cannot be considered as poisonous in the strict sense of the word, *i. e.*, capable of causing poisoning, fatal even in small amounts at any period of development, but some can cause serious illness, often even followed by death, when eaten by cattle in large quantities during the advanced flowering stage or when ripe. The species most commonly held to

be dangerous are: *Brassica nigra* Koch, *Br. Sinapistrum* Boiss., *Br. campestris* α *oleifera* D. C., *Eruca sativa* Mill, *Lepidium Draba* L., *Erysimum cheiranthoides* L., etc.

Thlaspi alliaceum is fairly rare in Italy, and very rare in Venetia. Neither this variety nor *Thl. arvense* should be given to cattle; when cows eat it their milk assumes a disagreeable garlicky smell. On the Pettorazza farm mentioned above the first fatal case occurred 5 or 6 hours after the last meal, the other cases after about 20 hours. The oxen were from 9 to 15 months old. The clinical symptoms were convulsions, shivering, weakness, etc. An examination of the blood showed the absence of pathogenic microorganisms. The post-mortem showed effects different from those generally observed in the case of poisoning in that the breathing tubes and stomach were very slightly affected. According to the author this is due to the rapidity with which the blood absorbs the poison (allyl sulphocyanate) thus causing death before the pathogenic effects could manifest themselves.

As in the Rovigo province the district infested with *Thl. alliaceum* is limited by the lower course of the Adige and the Bianco canal, the author believes it would be possible to exterminate the plant completely by a systematic destruction before the seed are ripe.

655 — Researches on the Malady "Trembles" or "Milk Sickness", Caused by *Eupatorium ageratooides* in North Carolina, U. S. A. (1). — CURTIS, R. S. and WOLF, F. A., in the *Journal of Agricultural Research*, Vol. IX, No. 11, pp. 397-404 + 2 Figs. Washington, June 1, 1917. — WOLF, F. A., CURTIS R. S., KAUPP, B. F. (Agricultural Experiment Station of North Carolina), in the *Journal of the American Veterinary Medical Association*, Vol. LII, New Series, Vol. V, No. 7, pp. 820-827 + 2 Figs. Ithaca, N. Y., March, 1918.

Of late years the authors' attention has been directed to a serious disease of domestic animals, including horses, cattle, sheep and hogs, which is commonly called trembles. This disease is transmissible to man through the milk of animals affected with trembles, and thus physicians call it "milk sickness". It has been known to be endemic in Tennessee, Kentucky, Ohio, Indiana, Illinois, Missouri and Georgia, since their first settlement and in North Carolina since the American Revolution. It was first described in 1810, but there is considerable confusion as regards the etiology of the disease, the etiological factors usually considered being 1) poisonous minerals (arsenic, copper, mercury, cobalt, lead, and aluminium); 2) a microorganism (*Bacillus lactimorbi*); and 3) a poisonous plant. The first 2 theories are not well supported by facts, whilst the third has 2 important points in its favour: - a) the malady disappears when the natural vegetation is replaced by cultivated plants; b) it is limited to the grazing season. A number of species of plants have been considered as causing "trembles", *Eupatorium ageratooides* (= *urticaefolium*) being most commonly held to be the cause.

Work published by MOSELEY, in 1906, confirms the opinion, held since 1840, that this plant, known as "white snake root", is the cause of the disease. The authors have adduced further proof by obtaining the disease in sheep, pigs, and guinea pigs fed with concentrated foods and white snake root.

(1) See also R., February, 1918, No. 170. (Ed.)

The symptoms include : -- nervous spasms followed by paralysis of the limbs ; congestion of the brain, liver, heart and kidneys ; hyperaemia of the lungs ; mucoenteritis.

The incubation period of the disease varies from 3 days to 12 weeks or more ; the period between the appearance of the symptoms and the death of the animal (only a small proportion recovers) is from 12 hours to 3 or 4 days.

There is no certain method of treatment ; the only preventive measure consists in ploughing the areas infested by *E. ageraioides*, which is a perennial, and sowing them to cultivated forage plants. Timberland infested with the plant, and which cannot be ploughed up, should be fenced in, to keep the stock out.

Mr. MOSELEY's work is confirmed by the authors' experiments with sheep fed on green " white snake root " plants from June to October, 1916. Out of 18 experimental animals, 15 showed signs of trembles, while 14 died and 1 recovered. It is possible that one of the fatal cases was due in part to an infestation of stomach worms. Death ensued from 5 to 27 days after the animals had commenced to eat white snake root. Considerable variation existed in the several ewes, also, with reference to the quantity of weed ingested before trembles appeared. Indirect evidence against the infectious nature of the disease was secured by failure to communicate trembles from sheep characteristically affected to healthy sheep when they were confined and fed together in a small lot. Common stock salt (8 oz. and 12 oz. per head in 11 and 18 days) and baking soda (30 oz. per head in 19 days) given together with a mixed ration of *E. ageraioides* and grain were without apparent antidotal effect.

It has been claimed that aluminium phosphate causes a disorder similar to that following the feeding of white snake root, but the authors found no harmful effect to follow the feeding for 69 days of aluminium phosphate mixed with grain and supplemented with alfalfa hay.

656 - **Investigations on the Etiology and Control of Infectious Abortion in Mares, in Kentucky, U. S. A.** — GOOD, E. S. and SMITH, W. V., in *Kentucky Agricultural Experiment Station, University of Kentucky, Bulletin* No. 204, pp. 337-395 + 18 Tables, Bibliography of 29 works, + 13 Pl. Lexington, 1916.

In 1907 the Department of Animal Husbandry of the University of Kentucky equipped a bacteriological laboratory for the study of infectious abortion in cows and mares at the Kentucky Agricultural Experiment Station. At that time it was generally supposed that this disease in both these species of animal was caused by the same organism. Furthermore, the fact had not been established that the organism causing abortion abroad and in the United States was the same.

In 1896, Dr. BANG isolated *Bacillus abortus*, an organism now conceded to be the cause of abortion in the cow. Although he never isolated the organism from an aborting mare, he produced cases of abortion in mares experimentally by infecting them with the bacillus and concluded that the bacillus caused the disease in the mare as well as in the cow.

In 1911, the Kentucky Laboratory isolated *Bacillus abortus* Bang from aborting cows. At the same time, a number of cases of abortion in

mares were examined, but no causal organism could be found. The cause of the disease in cows being well established, the Laboratory concentrated its efforts on isolating the germ causing abortion in the mare, and succeeding in isolating a microorganism called *Bacillus abortivo-equinus* from the uterine exudates and foetuses of aborting mares. The experiments described in the Bulletin in question prove that this bacillus is the causal agent of abortion in mares.

During the experiments numerous studs and cases were investigated by the Laboratory, and studies were made regarding: — the morphological, cultural and physiological characteristics of the bacillus; the agglutination and complement fixation tests; inoculation experiments; the production of a hyperimmune serum; immunization tests with a bacterin made from *Bacillus abortivo-equinus*; the effect of methylene blue, hexamethyleneamine, carbolic acid, and potassium permanganate on the organism.

RESULTS OF THE EXPERIMENTS. — In confirmation of their previous experiments, the authors continue to find a bacillus belonging to Subgroup II of the *Colon-typhi* group as the etiological factor of infectious abortion in mares and jennets; they propose the name of *Bacillus abortivo-equinus* for the organism.

By cultural, agglutination and complement fixation tests, the organism found not to be identical with other pathogenic organisms of Subgroup II of the *Colon-typhi* group, such as *Bacillus suispestifer*, *B. paratyphosus A*, *B. paratyphosus B*, *B. paracoloni*, *B. enteritidis* Gaertner and *B. typhi-murium*.

The *Bacillus abortivo-equinus* varies in its physiological property of splitting lactose and saccharose, for it produced approximately 2 % of gas and 2.5 % of acid in 1 % lactose broth in 86 % of 116 trials and no gas in 14 % of these trials, while in 1 % of saccharose broth slightly less than 2 % gas and about 0.2 % of acid were produced in 50 % of 56 trials, and no gas with this sugar in 50 % of the trials. It was found that *Bacillus enteritidis* Gaertner, belonging to the same subgroup of the *colon-typhi* group as *B. abortivo-equinus*, contrary to the generally accepted literature, produced 2 % gas in lactose in 75 % of the trials and in saccharose broth a small amount of gas was produced in 1 out of 7 trials.

The disease of infectious abortion in mares may be diagnosed by the isolation of *Bacillus abortivo-equinus* and by the agglutination and complement fixation tests.

A one-tenth of 1 % solution of potassium permanganate destroys *B. abortivo-equinus* in 1 minute. A 1 % solution of carbolic acid also destroys it in 1 minute. A 1 per 1000 solution of methylene blue destroys the organism in 5 minutes, while a saturated solution of boric acid destroys the germ in 3 hours. All these solutions in the strengths mentioned can be used as douches and not injure the mare. The water used should first be boiled, the chemicals added and cooled to body temperature before injection.

Subcutaneous injections of *B. abortivo-equinus* produced abortion in sinea pigs and rabbits, and an intravenous injection of the organism produced abortion in the hog and sheep. The feeding of large amounts of the

germ to a pregnant sow produced no injury whatever, and the subcutaneous injection, also the feeding of the organism to pregnant ewes did not produce abortion.

The intravenous injection of small amounts of the bacillus in horses resulted only in lassitude for a few days, while a large dose given intravenously and repeated produced death, with the recovery of the organism from the internal organs of the animal.

An intravenous injection of 2 cc. of physiological salt suspension of *B. abortivo-equinus* in a pregnant mare produced abortion in 10 days, and the organism was recovered from the uterine exudate of the aborting mare and from the internal organs of the foetus. An injection of 1 cc. produced abortion in 12 days.

The growth of *B. abortivo-equinus* on large agar tubes flooded with sterile water, mixed with grain and fed to a pregnant mare produced a persistent diarrhoea which would not yield to medical treatment, resulting in the death of the mare 20 days after. Streak dilutions made of the internal organs of the mare and foetus on plain agar revealed the presence of *B. abortivo-equinus* in the heart blood of the mare and liver of the foetus, thus showing that the bacillus had passed through the intestinal walls to the blood stream of the mare and foetus and would have caused abortion had the mare lived.

A bacterin made by growing the organism on plain agar, flooded with physiological salt solution and heated to 60°C. for 2 hours protected rabbits against 10 times the lethal dose of the organism.

The subcutaneous injection of quite large doses of bacterin (killed organism), in pregnant mares, produced no ill effects, save an occasional abscess at the seat of inoculation. The injected mares produced live, healthy colts.

A mare receiving a bacterin in increasing doses, subcutaneously, and afterwards injected subcutaneously with increasing doses of the live organism, delivered a live, weak colt which soon developed into a strong individual. The treatment greatly depressed the mare. Soon after delivering the foal she began to mend, and, 4 months after, was in excellent condition. It is quite probable that the treatment with a bacterin had protected her from aborting when later quite large doses of the live organism were injected subcutaneously.

Increasing doses of a bacterin, followed by an intravenous injection of 2 cc. of a suspension of the live organism in physiological salt solution did not give a pregnant mare sufficient protection to deliver a healthy foal. While the colt came alive, it was a "sleeper" and died 22 hours after delivery.

A hyperimmune serum for infectious abortion in mares was produced that had marked bacteriolytic properties in vitro. This serum protected rabbits from the lethal dose of the organism. In one case, it protected from 5 times the lethal dose. The serum did not protect a mare from artificial infection, the mare aborting 12 days after receiving the live organism intravenously. The amount of the germ given, however, was vast

excess of an infection which could have been obtained naturally. The serum may prove of value in a stud where infection is known to exist.

From these investigations it is concluded that a bacterin made of *B. abortus-equinus* injected subcutaneously will, if given to a pregnant mare in proper and increasing doses, do no harm and will, in all probability immunise her against the disease of infectious abortion if the bacterin be administered before the disease is contracted in a natural manner. In the production of this bacterin, the bacillus is grown on agar slants and the culture then washed 3 times with normal salt solution in a centrifuge.

57 - **The Amino-Acid Minimum for Maintenance and Growth, as Exemplified by Further Experiments with Lysine and Tryptophane.** — OSBORNE, THOMAS B. and MENDEL, LAFAYETTE B. with the Cooperation of FERRY, EDNA L. and WAKEMAN, ALFRED J. (Laboratory of the Connecticut Agricultural Experiment Station and the Sheffield Laboratory of Physiological Chemistry in Yale University, New Haven), in *The Journal of Biological Chemistry*, Vol. XXV, No. 1, pp. 1-12, 14. Diagr. Baltimore, Md., May, 1916.

Additional experiments are reported in this paper to show the part played by tryptophane and lysine in the metabolism of maintenance and growth. The quantity of these amino-acids available in the diet can be made the limiting factors which determine the nutritive equilibrium and possibilities for increment of size in an individual. They afford an important illustration of the "law of minimum" applied to essential nitrogenous components of the food supply.

58 - **The Effect of the Amino-Acid Content of the Diet on the Growth of Chickens (1).** — OSBORNE, THOMAS B. and MENDEL, LAFAYETTE B. (Laboratory of the Connecticut Agricultural Experiment Station and the Sheffield Laboratory of Physiological Chemistry in Yale University, New Haven), in *The Journal of Biological Chemistry*, Vol. XXV, No. 2, pp. 293-300 + 1 Plate. Baltimore, Md., September, 1916.

Experiments on the feeding of albino rats have shown that for adequate growth a suitable supply of certain amino-acids must be available in the diet. Conspicuous among them are tryptophane, lysine and cystine. Nutrition which fails to yield these in reasonable abundance cannot promote growth but, if the other (non-protein) dietary factors are suitable, increment of weight can promptly be brought about by the addition of these essential amino-acids. BUCKNER, NOLLAU, and KASTLE have attempted to test the validity of the conclusions just expressed, in a series of feeding experiments on young chicks, by using grain mixtures which they believed to exhibit a low and high lysine content respectively. The outcome was interesting in showing unmistakable differences in the growth of the birds in the two groups.

Believing that the conclusion of BUCKNER, NOLLAU and KASTLE in respect to the relative amounts of lysine yielded by their foods was in the main correct, although unproved, the authors have concluded to attempt the application to the chick of the methods of feeding mixtures of more definitely known lysine content. The plan of the experiments was to compare the growth of chicks (Rhode Island Reds) fed on diets which, in one case contained "corn gluten", the mixed proteins of which yield about 1 per cent of lysine, and in the other case contained equal parts of "corn gluten"

(1) See also R., April 1918, No. 442. (E.L.)

and lactalbumin, a protein yielding about 10 per cent of lysine. The food mixtures contained, aside from the protein ingredients the essential substances including inorganic salts, fat-soluble and water-soluble hormones, which experience with rats has shown to be required for perfect growth.

Two types of food were employed. One, the "fat food", was made in the form of a paste by grinding the ingredients together with a sufficient quantity of lard and butter fat; the other, the "starch food", was made in the form of a coarse meal by substituting starch for a large proportion of the fat in the "fat food". In one experiment the total gain of body weight in 55 days was 52 gm. for the chick on corn gluten food; 283 gm. for the chick on corn gluten + lactalbumin food; in another a chick at the age of 81 days had gained 322 gm. in a period of 53 days, on the corn gluten + cottonseed flour ration, while at the same age a chick on the corn gluten food had increased in weight only 44 gm.

These results are in agreement with the writers' observations upon rats receiving similar diets. We thus see that corn gluten permits a very slight growth of chickens as well as of rats, because it contains some maize gluten -- a protein which yields tryptophane as well as a little lysine. With chicks, as with rats, lactalbumin, rich in both tryptophane and lysine, is an efficient adjuvant to the proteins of corn gluten.

Therefore these observations corroborate, for the chick, the experience which the authors have previously published regarding the unlike value of different proteins in the nutrition of growth.

In further accord with the observations on the growth of rats, cottonseed flour also forms a suitable adjuvant for the proteins of corn gluten, whereby in the presence of "protein-free milk", butter fat, etc., satisfactory increments of growth can be obtained. Two chicks beginning at the age of 28 days on a corn gluten + cottonseed flour ration gained 450 gm. and 556 gm. respectively in 79 days.

The results confirm the conclusions drawn by BUCKNER, NOLLAU, and KASTLE respecting the effect of foods high and low in lysine on the growth of chickens. The assumption is justified that chickens, as well as rats, require a sufficient amount of lysine in order to make normal growth and that will doubtless be found true for other species.

*659 -- **Studies on the Nutritive Deficiencies of Wheat and Grain Mixtures and the Pathological Conditions produced in Swine by their Use.** -- HART, E. B., MILLER, W. S. and MC COLLUM E. V. (Departments of Agricultural Chemistry and Anatomy of the University of Wisconsin, Madison), in *The Journal of Biological Chemistry*, Vol. XXV, No. 2, pp. 239-259, 9 Diagr. + 5 Plates. Baltimore, Md., June, 1916.

In earlier studies on the influence of restricted natural feeds on growth and reproduction it was observed that a ration from the wheat plant -- wheat grain plus wheat straw -- was wholly inadequate with heifers for reproduction and in some instances for continued growth. With swine, confined to the wheat grain and a suitable salt mixture, growth soon ceased and the animals passed into a poor condition, while a maize and salt mixture ration was at least sufficient for slow growth and continued well-being. Similar results are on record with rats, and only when a liberal supply of

casein and fat-soluble *A* was added to a wheat grain and salt mixture was growth continuous and, in the case of rats, reproduction possible.

In earlier papers the authors have expressed the view of the possibility of inherent toxicity in the wheat kernel, a view now made probable by the fact that the wheat embryo yields by ether extraction an oil of distinct toxicity and a residue far more innocuous than the embryo itself. That this embryo carries a considerable quantity of a toxic substance is further shown by the fact that, on increasing the mass of embryo in the rations of herbivora, earlier abortions are produced than when the ration carries the whole wheat grain only. When the diet of swine consisted of whole wheat gluten plus a suitable salt mixture the individual soon failed to grow and passed into a pathological condition. Loss of weight, rough coat, emaciation, lack of muscle coordination, laboured breathing, and even blindness manifested themselves. Experiments with rats showed that with abundance of better proteins from milk powder or casein, a more efficient salt mixture and the addition of fat-soluble *A*, and with whole wheat constituting approximately 65 per cent of the ration, the depressing action of this toxicity could be overcome.

With swine receiving similar additions to the wheat grain, but not in the same quantitative order, growth was normal but reproduction failed. It is important in this connection to call attention to the fact that when the additions to wheat were only salts and butter fat but without casein, the curve of growth was improved, but ultimately these animals failed with symptoms similar to those shown on the wheat, salt mixture diet. It became evident as this work with swine progressed that these pathological conditions manifested by swine are, as far as the histological picture of the spinal cord is concerned, analogous to, if not identical with, the pathological condition recorded for polyneuritis in fowls, but here induced by an inherent toxicity and not by a deficiency. Therefore malnutrition, histologically characterized by nerve degeneration, may result from the absence of certain factors in the diet as in the case of beri-beri. A similar condition may likewise arise from the presence of toxic materials in apparently normal food products, and in the presence of all known factors essential for continued growth and well-being.

With a large mass of wheat in the ration of swine toxicity will follow even in presence of all the recognized factors for growth. Only in the presence of very liberal quantities of all these factors can the effect of the toxicity be overcome. No one important factor for growth, such as better proteins, salts, or fat-soluble *A*, appears able to act as a complete corrective for this toxicity.

It also appears possible to produce similar pathological conditions in swine in the absence of all known toxic material and in the presence of a fair quality of protein, a plentiful supply of fat-soluble *A*, and water-soluble *B*, but a poor salt mixture; namely, that natural to the grains used.

Excellent supplementary materials to the grains even in the presence of the toxicity of the wheat products, have been found in alfalfa and commercial meat scraps. Probably milk, if used in sufficient quantity, would

also serve this purpose admirably. The factors introduced by alfalfa are undoubtedly an abundance of fat-soluble *A* and a better salt mixture. Its richness in calcium may be important. With commercial meat scraps the factors for improvement are undoubtedly better proteins, more fat-soluble *A*, and a liberal supply of calcium phosphate resident in the bone material it carries.

660 - **The Stability of the Growth Promoting Substance in Butter-Fat.** — OSBORNE, THOMAS B. and MENDEL, LAFAYETTE B. with the cooperation of FERRY, EDNA L. and WAKEMAN, ALFRED J. (Connecticut Agricultural Experiment Station and Yale University, New Haven), in *The Journal of Biological Chemistry*, Vol. XXIV, No. 1, pp. 37-39. Baltimore, Md., 1916.

A considerable number of observations are now on record to show that certain mixtures of isolated food substances furnishing a ration upon which animals (albino rats) decline or cease to grow can be converted by the addition of some of the natural "fats" into a ration adequate for growth. The authors have found that the inefficiency of lard and some other fats in this respect is not due to the destruction of the growth promoting factor by heat since these fats fail to promote growth adequately even when they are prepared at low temperatures in the laboratory. Furthermore they found that butter fat does not lose its growth-promoting potency by treatment with live steam; and the yolk extracts of heated eggs have also been reported as effective. From such facts it seems unlikely that the explanation of the ultimate failure of growth when certain of the natural fats supply the fat component of the diet is to be found in some destructive reaction brought about by preliminary heating. McCOLLUM and DAVIS believe that the substance which exerts a stimulating action on the growth of rats is sufficiently stable to withstand conditions of saponification which they have employed.

The authors have found that by fractional crystallization from alcohol it is possible to concentrate the growth-promoting factor present in butter-fat and beef fat. It remains in the mother liquor or "oil" fractions, whereas the fractions containing the fats with high melting points are ineffective. In order to learn whether the growth-promoting substance retains its physiological potency when kept for long periods, samples of butter fat and butter "oil" were stored: 1) at 18°C., in the light; 2) at 18°C. in the dark; 3) at 8° C. in the dark. Their efficiency in restoring growth, etc. was subsequently tested on animals that had failed on the "lard diets." The results indicate the pronounced stability of the growth-promoting substance as contained in butter fat under ordinary conditions of storage. However, in the butter "oil" gradual deterioration occurred, so that within a year its characteristic growth-promoting potency was eventually almost completely lost.

The feature here involved has a practical bearing in relation to the storage of butter and other fat products.

661 - **A Vitamine Favouring Growth, Isolated from the Pancreas of the Sheep.** — EDDY, W. H. (Chemical Laboratory of the New York Hospital), in *The Journal of Biological Chemistry*, Vol. XXVII, No. 1, pp. 113-126 + 9 Diagrams. Baltimore, 1916.

By treating the water-soluble part of the alcoholic extract of the sheep pancreas with Lloyd's reagent, the author isolated a substance which when fed to rats, was found capable of aiding their growth.

This substance, which is separated from the extract as a phosphotungstic precipitate, is neither a protein, nor a fat, nor an amino-acid combination.

62 - **The Nature of the Dietary Deficiencies of the Wheat Embryo** (1). — MC. COLLUM, E. V., SIMMONDS, NINA and FITZ, WALTER (Laboratory of Agricultural Chemistry of the Wisconsin Experiment Station, Madison), in *The Journal of Biological Chemistry*, Vol. XXV, No. 1, pp. 105-131, 19 Diagr. Baltimore, Md., May, 1916.

The experiments reported in this paper reveal the fact that the wheat embryo contains qualitatively all the factors essential for the promotion of growth and well-being in an animal, but these are not so proportioned that they can serve as a satisfactory diet without several modifications.

The mineral content must be modified in certain respects before growth can proceed at all.

The character of the proteins is excellent; no other proteins from plant sources which the authors have studied are superior to them. Rations containing but 10 per cent of these proteins are wholly adequate for growth at the maximum rate.

Both the fat-soluble *A* and the water-soluble *B* are present; the first, in moderate concentration; the second, in very high concentration as measured by the needs of the growing animal. Two per cent of wheat embryo supplies enough of the water soluble *B* to promote growth at the normal rate for several months.

There is contained in the wheat germ a substance which is distinctly toxic to animals. This is in great measure removed by extraction with ether, and is found in the fat fraction. The writers have not yet determined whether the toxicity is due to peculiarities in the chemical nature of the fats themselves or to something which is associated with the fats.

63 - **Studies of Cotton-seed as Food** (2). — I. WELLS, C. A. and EWING, P. W., Cottonseed Meal as Incomplete Food (Georgia Experiment Station), in *The Journal of Biological Chemistry*, Vol. XXVII, No. 2, pp. 15-25, Bibliography of 8 publications. Baltimore, Md., 1916. — H. OSBORNE, THOMAS B. and MENDEL, LAFAYETTE B., The Use of Cotton Seed as Food (Laboratory of the Connecticut Agricultural Experiment Station and the Sheffield Laboratory of Physiological Chemistry in Yale University, New Haven), *Ibid.*, Vol. XXIX, No. 2, pp. 289-317, 5 Diagr. Baltimore, Md., March, 1917.

I. — The results of former experiments (WELLS and EWING, Acidosis and Cotton-seed Meal Injury, *Georgia Agricultural Experiment Station*, Bulletin 119, 1916) had indicated that in feeding cotton-seed meal to pigs to ascertain the injury said to result from this it is necessary to balance the ration, not so much as to the nutritive ratio, determined by the amounts of fats, carbohydrates, and protein present, but rather as to the so-called accessory food factors. The present paper relates the writers' further experiments bearing upon this phase of the question. They were carried out on Duroc Jersey pigs; the conclusions arrived at are as follows: —

Cotton-seed meal is an incomplete food. This is true even when it is fed with sugar and starch to a wide nutritive ratio.

(1) See *R.*, January 1918, No. 1. (Ed.)

(2) See also *R.*, January 1918, No. 64; March 1918, No. 306; April 1918, No. 443. (Ed.)

Pigs upon an absolute maintenance diet ate in addition only small quantities of cotton-seed meal and were not greatly injured by it.

So called cotton-seed meal injury is due in large part to inadequate diets.

II. — Cotton-seed meal is one of the most valuable feedstuffs at the command of the American stockman. After the animal has digested it, the value of the residue as fertilizer is about three-fourths the original value of the meal. The United States uses only part of the cotton-seed meal which it produces and one of the reasons which prevent a larger domestic consumption of this by-product of the cotton industry is the danger that sickness and death may follow its use. Cattle fed for more than 90 to 120 days on a heavy cotton seed meal ration (6 pounds or more per head daily) become lame, and their eyes discharge freely, blindness often resulting. Deaths may occur, especially in young animals. Pigs are peculiarly susceptible to the effects of cotton-seed meal, possibly because they are usually fed a larger quantity of the meal in proportion to their body weight. In feeding pigs, symptoms of sickness may appear at any time after 3 weeks of feeding, and deaths frequently occur with little warning. Various systems of feeding cotton-seed meal to pigs have been devised. Some of them appear to minimize its danger somewhat, but none of them prevent it entirely. This product, therefore, can not be regarded as a safe feed for pig in the combinations in which it has heretofore usually been fed. (ROMMEL, G. M., and VEDDER, E. B., *Journal of Agricultural Research*, Vol. V, p. 489, 1915).

Referring to the experiments in feeding cotton-seed meal which have been made by various agricultural station workers, WELLS, C. A., and EWING P. V. (*Georgia Agricultural Experiment Station, Bull.* 119, 1916) state that the results of such experiments do not entirely agree and few absolute conclusions can be drawn from them. They indicate, however, that swine (particularly young pigs), calves, sheep, horses, cows, steers, dogs, cats, guinea pigs, rabbits, fish, poultry, and other animals may be injured by eating cotton-seed meal. Some of the smaller animals, such as pigs and calves, seem to be more susceptible to its injury than cows, steers, and similar animals. This, however, may have been due to their youth, or, more probably, to a consumption of larger quantities of meal in proportion to their live weight. When the meal was fed in connection with pasturage, or when it had been steamed, boiled or fermented, or when fed with mineral matter, particularly iron compounds, it often seemed to exert no apparent injury to pigs even when fed in rather large quantities. The injury resulting from the feeding of cotton-seed meal to stock has been attributed to *a*) the oil in the meal; *b*) its crude fibre; *c*) excess of nitrogen and perverted metabolism; *d*) the action of bacteria and moulds; *e*) presence of betain, cholin, or other alkaloids, and to gossypol; *f*) to injurious phosphoric compounds; *g*) to a protein group containing loosely bound sulphur which interferes with normal iron metabolism; *g*) to worms and certain other causes of minor importance.

Cotton-seed products for feeding purposes are available in several commercial forms. Cotton-seed *kernels* are obtained when the whole cotton

seed is decorticated and freed from most of the hulls. Cotton-seed *meal* is the term applied to the ground cotton-seed cake from which most of the oil has been pressed. Cotton-seed *flour* is prepared by finely grinding and sifting the meal, whereby the lint, etc., are removed more completely than from cotton-seed meal.

Two processes are commonly employed in preparing cotton-seed meal. In the first process the seeds are decorticated, ground, and then steamed for about $\frac{1}{4}$ of an hour. The hot mass is freed from most of the oil by means of hydraulic presses and the resulting press cake is then ground to a meal. In the second process the oil is expressed from the seeds by means of Anderson expellers whereby the meal becomes heated. The residue is then ground as in the first process. The second procedure is frequently called the cold process. Nearly all of the mills in the United States use the method employing live steam.

MARCHLEWSKI, L., (*Journal für praktische Chemie*, Vol. LX, p. 84, 1899) isolated from the "foots" from cotton-seed oil a substance which he named gossypol. WITHERS, W. A. and CARRUTH, F. E. (*Journal of Agricultural Research*, 1915, Vol. 261) (1) have isolated this from cotton-seed kernels, by extraction with fat solvents and they report it to be highly toxic to rabbits, guinea pigs, rats, and pigs. They state that the ether-extracted kernels are rendered non-toxic by removal of gossypol. According to WITHERS and CARRUTH, "cotton seed meal and flour were found toxic to rabbits but the flour produced no ill effects on rats". The unlike toxicity to rats is explained by the variation in alteration or removal of gossypol in the manufacture of the meal from the kernels.

To ascertain whether the cotton-seed proteins are, like some proteins from maize, notably deficient for the purposes of nutrition the authors have conducted feeding experiments on white rats for which cotton-seed proteins furnished practically all of the food nitrogen and for which the other essential dietary components were supplied by adding to the products to be tested a suitable mixture of protein-free milk, butter fat, and starch which, with the addition of adequate protein, is sufficient for perfect growth. In this way they have found that satisfactory growth can be made by rats when either cotton-seed *globulin*, or the total cotton-seed protein precipitated from alkali extracts of cotton-seed meal, is employed without significant amounts of other protein in the mixture.

The facts now available are briefly summarized below.

Cotton-seed *kernels* are unsatisfactory for nutrition. Cotton-seed *meal* and *flour* are valuable foods for growing rats, both when used as the sole source of protein in the food, or when used in smaller quantity to supplement other less efficient protein concentrates. The excellent "quality" of the cotton-seed proteins as a whole is attested by the satisfactory growth made on diets furnishing the equivalent of only 9 per cent of protein ($N \times .4$); even with 6 per cent of the protein considerable growth ensued. Cotton-seed *flour* gave good results when used as a supplement to such deci-

(1) See also R., January 1918, No. 64; March 1918, No. 306. (Ed.)

dedly inferior protein concentrates as "corn gluten", distillers' grains, and "vegetable albumin flour".

The injurious substance in the *kernels* can be removed by extraction with ether and, according to WITHERS and CARRUTH, by extraction with carbon bisulphide, chloroform, benzene, or alcohol, but not with petroleum ether or gasoline. The ether soluble material is deleterious, either because it contains some toxic ingredient or because it renders the food containing it so unpalatable that the animals refuse to eat it. This agrees with the results obtained by WITHERS and CARRUTH and by McCOLLUM, SIMMONDS and PITZ.

Foods containing cotton-seed oil prepared by pressing the kernels in the cold, or furnished as the crude unbleached commercial oil prepared by heating the kernels before pressing them, are eaten without detriment by rats.

By treatment with steam under suitable conditions the *kernels* lose their deleterious effect on rats. The variations in the results of feeding different samples of cotton-seed meal, which have been reported, may be due to differences in the mode of heating which the products have experienced in their preparation.

As regards the question as to whether so called "cotton-seed injury" in the feeding of domestic animals can be classed with the deficiency disease it is quite possible that, as ROMMEL and VEDDER maintain, food mixtures lacking some of the now recognized essential ingredients of an adequate diet have been employed in the past. The authors' experience with rats successfully grown on cotton-seed rations excludes the probability that there is ordinarily any lack of the water-soluble vitamins. Whether the quota of inorganic salts furnished in agricultural practice is always sufficient the writers are unable to answer. It is noteworthy, however, that they have induced young rats to double their weight at a normal rate of growth on a food mixture containing nothing except cotton-seed meal, starch, and lard. The deleterious effects of unheated cotton-seed *kernels* cannot be denied. Whether the reputed detrimental effect after feeding some of the commercial cotton-seed meals is associated with a failure to destroy a deleterious constituent or is attributable to unsuitable methods of feeding in some cases is still debatable.

664 - Test of Three Protein Concentrates and Two Leguminous Roughages in Milk Production.

— HUNZIKER, O. F. and CALDWELL, R. E., in the *Purdue University Agricultural Experiment Station Bulletin No. 203*, pp. 1-20. Lafayette, Indiana, August, 1911.

Results of an experiment designed to give directions to feeders of dairy cows, regarding the type of protein-carrying concentrates and leguminous roughages best adapted for maximum and economical milk yield.

The three protein-carrying concentrates under test were cottonseed meal, linseed meal and gluten feed, and the hays fed were alfalfa hay and soybean hay; ground maize and maize silage were included in all rations.

The experiment covered a period of 180 days and was divided into six periods of 30 days each, 15 cows being used, divided into 3 lots of 5 cows each.

The rations used in the experiment are given in the following schedule :

1. Ground maize, cottonseed meal, alfalfa hay and maize silage.
2. Ground maize, cottonseed meal, soybean hay and maize silage.
3. Ground maize, linseed meal, alfalfa hay and maize silage.
4. Ground maize, linseed meal, soybean hay and maize silage.
5. Ground maize, gluten feed, alfalfa hay and maize silage.
6. Ground maize, gluten feed, soybean hay and maize silage.

The cows used were : 13 pure bred Jerseys and 2 pure bred Ayrshires fresh approximately 75 days before they were placed in the experiment.

The average daily feeds consumed during the entire experiment are shown in Table I.

TABLE I. — *Showing Average Daily Feeds consumed — Entire Experiment.*

Ration	Ground maize lb.	Cottonseed meal lb.	Linseed meal lb.	Gluten feed lb.	Alfalfa hay lb.	Soybean hay lb.	Maize silage lb.
1	7.88	0.49	—	—	8.52	—	24.50
2	7.44	0.78	—	—	—	7.43	25.07
3	7.66	—	0.55	—	8.54	—	25.00
4	7.40	—	1.06	—	—	7.65	24.81
5	7.24	—	—	0.90	8.27	—	25.10
6	6.02	—	—	1.61	—	7.62	25.24

The average daily production of milk for each of the 6 periods of the experiment was not especially high, averaging 19.64 lb. for all cows when receiving alfalfa hay and 18.41 lb. for all cows when receiving soybean hay. The low daily milk production may be accredited to the fact that the cows were mostly pure-bred Jerseys, having a rather high fat content.

Table II shows the amount of dry matter required to produce a unit of product.

TABLE II. — *Showing the Amount of Dry Matter Required to Produce a Unit of Product.*

Ration	Average daily milk produced lb.	Average daily butter fat produced lb.	Average daily dry matter consumed lb.	Dry matter required per 100 lb. milk lb.	Dry matter required per pound butter fat lb.
1	20.18	0.9224	22.899	113.42	24.76
2	19.93	0.9346	22.901	121.99	25.88
3	19.85	0.9064	22.605	114.92	24.47
4	17.31	0.8161	21.120	113.75	24.35
5	18.89	0.8822	21.483	113.85	24.94
6	17.98	0.8246	20.817	115.74	25.25

The cost of the product, considering feed cost alone (1), is given in Table III together with the value of the product, calculating all butter fat at 30 cents per pound and the skim milk at 25 cents per hundred pounds.

TABLE III. — *Showing Cost of Product.*

Ration	Average daily cost of feed	Average daily value of product	Cost per 100 pound milk produced	Cost per pound butter fat produced	Production per \$ 1.0 worth of feed
1	\$ 0.1925	\$ 0.32	\$ 0.98	\$ 0.216	1.605
2	0.1901	0.28	1.10	0.234	1.464
3	0.1997	0.32	1.00	0.213	1.602
4	0.1990	0.30	1.05	0.226	1.523
5	0.1968	0.31	0.99	0.218	1.589
6	0.1895	0.28	1.05	0.229	1.498

The average daily cost apparently was not influenced by the type of protein-carrying concentrates used. The variation in cost was doubtless influenced chiefly by the roughage fed. The type of roughage used produced an average variation in the total value of the product from \$9.52 when alfalfa hay was fed to \$8.67 when soybean hay was fed, or about 4 cents per day.

The conclusions drawn as a result of the discussion of the data presented in the foregoing tables may be summarized as follows:—

A ration used in milk production, which contains ground maize, maize silage and a leguminous hay, requires a very limited amount of protein-carrying concentrates in order that it may be properly balanced. The three protein-carrying concentrates used in the experiment affected the cost of the ration less than any of the four feeds of which the ration was composed.

When fed in connection with alfalfa hay, cottonseed meal was the most economical source of protein, gluten feed ranking second and linseed meal standing third, using prices as shown in the note (1).

Alfalfa hay was 12 % more economical as a milk producing roughage than soybean hay, both selling at the same price per ton, and without taking into account the greater quantity of soybean hay refused, due to its unpalatable character. The cost of milk was affected to the greatest degree by varying the price of maize. Hay ranked second, maize silage third and the protein-carrying concentrates fourth. The hay and maize exert practically the same influence upon the cost of milk.

The use of soybean hay caused an increase in body weight and a decrease in daily milk and butter fat production.

Properly balanced rations were, approximately, equally efficient in the production of milk and butter fat per unit consumption of dry matter

(1) Prices of feeds used were as follows: Cottonseed meal \$ 30 per ton; linseed meal \$ 36 per ton; gluten feed \$ 28.50 per ton; ground maize \$ 0.60 per bushel; alfalfa hay \$ 15 per ton; soybean hay \$ 15 per ton; maize silage \$ 3.50 per ton.

665 - **Feeding with Maize Silage and Ground Cotton Cake: Its Influence on the Composition and Quality of the Butter.**—See No. 696 of this Review.

696 - **The Role of Water in a Dairy Cow's Ration; Investigations made in U. S. A.**—LARSEN, C., HUNGERFORD, E. H. and BAILEY, D. E., in *South Dakota State College of Agriculture and Mechanic Arts, Agricultural Experiment Station, Bulletin No. 175*, pp. 648-691 + 16 Tables. Huron, April, 1917.

Some dairymen claim that if the amount of drinking water given to a cow is limited, the body temperature is raised and the composition of the milk modified, the percentage of fat especially being increased. In order to verify this assertion the authors undertook a series of experiments (1) on the effect of watering cows at different intervals with varying quantities of water on the following factors:—amount of food consumed, digestibility of food, quantity and composition of faeces and urine, quantity and composition of milk, composition and quality of butter fat, body temperature and physical condition of the cow. Data on the mineral metabolism of the cow were so obtained. The experiment, carried out on four animals, was divided to three periods, separated by a period in which the ration was normal. In the first period the animals were watered every 24 hours (an average of 1.65 lb. per head), in the second period every 60 hours (an average of 51.20 lb. per head), in the third period with half the normal ration of water (40.00 lb. per head).

A series of tables gives:—Composition of feed and water; weight of animals, amount of food consumed and daily milk yield, coefficients of digestibility of the rations, amount of water drunk and food digested daily, daily amount and composition of the faeces, relation of amount of water to dry matter consumed, average daily amounts and composition of the urine and the milk, analysis of butter fat, average temperature of the shed and cows, effect of room temperature on the total amount and percentage of fat in the milk; food constituents digested per 1000 lb. of live weight daily, daily energy

(1) The effect of varying quantities of water in the ration on the composition of milk has been studied by many authors. TURNER, SHAW, MORTON and WRIGHT compared experimentally:—1) a full allowance, with a limited allowance of water; 2) a heavy ration of turnips with a dry roughage ration; 3) wet beet pulp with dry beet pulp; 4) green clover with cured hay. They proved that, though individual cows produced milk with an abnormal fat content, the different rations did not as a rule influence either the quantity or the composition of the milk.

GILCHRIST (Variations in the Composition of Milk and their Probable Causes, *Durham County Council Education Committee Reports, Dairy Investigations, Offerton Hall*, pp. 7-27; 1909) found little or no difference in the quantity and quality of milk produced by cows either on pasture or a heavy mangel ration and that produced by cows on a ration of hay and grain.

ARMSBY found that cows drink more when fed a heavy protein ration than when fed a low protein ration, and that cows fed dry roughage drink about 40 lb. more water per day than those fed green hay. (Authors.)

See also the summary of the results obtained by various workers in experiments on the influence of the composition of the ration on milk secretion, read by KELLNER at the International Dairy Congress held at Budapest, June, 1909, in the *Journal of the Board of Agriculture*, Vol. XVI, No. 8, pp. 640-654, London, November, 1909; the author proves the influence to be very slight. See also B. 1912, Nos. 150 and 682; 1916, No. 885; 1917, No. 347; 1918, No. 63. (Ed.).

requirement per 1000 lb. live weight, distribution of water in the cow's body, average daily rations and balance of food nutrients in the three periods of the experiment.

RESULTS. — 1) *Food consumed.* — When the cows are watered once in 24 hours instead of two or three times there is a slight decrease in the total amount of food taken and in the quantity of milk produced, but this second decrease is not proportionate to the first. During the 30 days of the experiment the animals lost an average of 11 lb. per head. This loss was much greater during the second test (17 lb.) and the third (95 lb. per head on an average).

During the periods in which the cows received a full ration of water at long intervals, the expected decrease in milk production was not obtained. If the slight decrease in the amount of food consumed and the loss in weight be considered it must be concluded that cows can utilise the water stored in their systems for milk production and other functions. When the cows only received half the normal quantity of water (test 3) there was a marked decrease in the amount of hay consumed, milk produced and in body weight.

2) *Digestion of rations.* — The coefficient of digestibility was increased in each of the tests in which the intervals between watering were lengthened and in those in which the cows only received half the normal ration of water. This increase in the coefficient of digestibility is particularly marked in the case of crude fibre. Cows watered once in 24 hours digested 55 % of crude fibre as compared with 54 % digested by the control animals watered three times a day; cows watered once in 60 hours digested 71.07 % of fibre as against 55.7 % by the control animals, and those receiving half a ration of water digested about 2 % more than the control animals.

The increase in the digestibility of the nitrogen free extract and of the protein is not regular and is less marked.

As regards the actual amount of crude fibre digested, the cows in test 1 digested about 0.09 lb. per head daily, and those in test 2 only 1.26 lb. more than the control animals, those of test 3 digested 1.125 lb. less than the control animals.

Numerous investigations have led to the general acceptance of the theory that the digestibility of crude fibre depends largely on the active bacteria present in the intestinal tract and the action of the digestive juices. It is probable that an increased amount of water retards bacterial action in digesting crude fibre, and that a decreased amount leaves the digestive juices more concentrated and, therefore, more efficient and makes the chyme firmer and slower in moving through the digestive tract so that it is exposed for a longer period to the action of the secretions in the tract.

These results show that to obtain the most efficient digestion of food it is wise not to water the animals too abundantly at feeding time or immediately before or after a heavy meal.

3) *Effects of the quantity of water ingested on the composition of the excreta.* — The percentage of water in the faeces and the urine varies but little with the different quantities of water ingested; there was almost no difference between the faeces of the control animals and those in tests 1 and 2

in test 3 there was a decrease of about 2 %. Frequent watering seems to have no appreciable effect on the composition of the faeces except that lengthening the intervals between drinking slightly reduces the crude fibre. When the cows only received half the normal ration of water there was an increase in the protein, nitrogen-free extract and crude fibre contained in the faeces.

When the cows received an unlimited supply of water three times a day they drank 3.5 lb. for every pound of dry matter consumed, when watered once in 60 hours they drank 2.38 lb. per pound of dry matter, and when receiving half the normal ration of water every 24 hours they drank 1.8 lb. per pound of dry matter.

4) *Effect of the quantity of water ingested on the quantity and composition of the milk.* — In all the tests the composition of the milk and butter fat remained absolutely unchanged. It is for this reason that a cow receiving insufficient water goes dry without there being any modification in the composition of her milk. Frequent watering has little influence on the quantity of milk produced. When the normal water ration was reduced by half the milk yield was reduced a little at the beginning, this reduction increasing as the experiment continued till it was about $\frac{1}{4}$. There is no doubt that the cows would have gone dry if this ration had been continued.

5) *Effect of water on the body temperature of the cow.* — When the cows were watered every 24 hours the body temperature was lowered by the fraction of one degree Fahrenheit 15 minutes after watering. With intervals of 60 hours the temperature dropped 2° F. The minimum was obtained 1 to 1½ hours after watering (1.30 lb. of water per head). The temperature of cows receiving half the normal ration of water was 1° F. higher than when they received a normal amount, but there was no increase in the fat content of the milk.

During a special experiment the cows were exposed to room temperatures varying from 51 to 104° F. It was found that the fat content tends to increase with the body temperature, though the increase is but slight; about 4.4% for 60° F. and 5.04% for 104.8° F. Since, however, high temperature slightly reduces milk secretion, the total amount of fat increases in inverse ratio to the percentage, in the case quoted from 11.2 lb. to 10.2 lb. per head daily. In conclusion it may be said that keeping dairy cows in milk in hot sheds, blanketing them and withholding water in order to raise the fat content is very dangerous to their health.

6) *Physical condition of the cows.* — The abnormal conditions brought about by withholding water were nervousness, gauntness and high body temperature. When the animals were watered every 60 hours and when they received half the normal ration of water a larger amount of energy was required to accomplish the body functions.

7) *Chief functions of water in a dairy cow's ration.* — The results of their experiments led the authors to the following conclusions: — A good dairy cow probably requires more water than any other domestic animal. Water dissolves food (for this reason the more food an animal eats, the more drink it requires), distributes it to the different parts of the body and removes the

waste products. The authors showed that more than 12 % of the total water drunk is eliminated through the skin in winter in the shed, and 27 % in August ; 56 % of the water drunk is eliminated in the faeces and 15 % in the urine. On an average, 15 % of the water drunk passes into the milk (in good milkers this percentage is higher; in one of the experiment animals, among which there were no choice cows, this percentage was 24 %). Water regulates the body temperature ; the loss of water through the body was twice as great in August as in January.

667 - The Influence of Parturition on the Composition and Properties of the Milk and Milk Fat of the Cow. — ECKLES, C. B. and LEROY, S. PALMER (Department of Dairy Husbandry, University of Missouri, Columbia), in *The Journal of Biological Chemistry*, Vol. XXVII, No 2, pp. 313-326. Baltimore, Md., 1916.

The general opinion prevails that cows' milk is not suitable for human food for a period of time after parturition. Opinion varies as to the length of time the milk is unfit for use, as low as 2 days and as high as 15 days being stated as the proper period by different authorities. The methods and standards for certified milk adopted by the American Association of Medical Commissions place the figure at 7 days after parturition. The basis for the exclusion of cows' milk immediately after the birth of the calf is that its composition or constituents give rise to intestinal disorders. The evidence upon which this conclusion is based is, however, extremely difficult to find.

The data which are offered in the present paper indicate that colostrum milk is subject to variations in composition, or in other words that the effect of parturition on the composition of cows' milk may be greatly influenced by other factors. Data are presented on two questions : 1) the effect of milking the cow up to the time of parturition ; 2) the influence of the length of the period the cow is dry before parturition.

The conclusions which the authors have drawn from these data are the following :—

Parturition in the case of the cow is normally accompanied by the production of milk of extremely abnormal composition, called colostrum.

When cows are milked up to parturition, however, the colostrum milk and milk fat are much less abnormal in composition and follow closely the composition of the milk and milk fat given before parturition.

The chief characteristic of the milk as the cow approaches parturition in these cases is the marked increase in the content of heat-coagulable proteins, which reach their maximum in the first milk following parturition, that is, the true colostrum milk. This would indicate that a high content of heat-coagulable proteins is the chief, if not the only, real effect of parturition on the milk.

The length of time the cow is dry before parturition is a factor influencing the composition of colostrum milk, but does not influence the composition of colostrum milk fat. The shorter the time the cow is dry the less abnormal will be the composition of the colostrum milk.

(1) See also *R.* April 1918, No. 445. (*Ed.*

68 - **Winter Steer Feeding in Indiana, U. S. U.** — SKINNER, J. H. and KING, G. F., in the *Purdue University, Agricultural Experiment Station, Bulletin No. 191, Vol. XIX*, pp. 1-35, Lafayette, Indiana, September, 1916.

The experiments described were undertaken to determine: — 1) the comparative value of leguminous hay alone and in combination with maize silage as roughage for fattening cattle; 2) the comparative value of clover hay and alfalfa hay as roughage for full-fed cattle; 3) the value of feeding molasses and mixed molasses feeds for fattening cattle; 4) the comparative value of a limited feed of maize with maize silage and a full feed of maize for finishing steers.

For the purposes of the experiment 70 medium feeding cattle were used. These were divided into seven lots of 10 steers each, as far as possible equal in size, condition, breeding, etc., and kept under similar conditions. The experiment lasted 150 days. With each lot of cattle were 10 good quality hogs, with an average weight of 105 lb. each when the experiment started. In addition to droppings from the cattle all the hogs received as much maize as they could eat; in addition five hogs in lots 2, 3 and 4 also received a small quantity of shorts and kitchen waste.

Maize silage and leguminous hay v. leguminous hay (Lots 2, 4, 3 and 7)

— The rations were composed of shelled maize, cottonseed meal (2.5 lb. daily per 1000 lb. live weight), clover or alfalfa hay, with and without maize silage.

The table shows that the addition of maize silage to the ration reduced the maize required and practically replaced hay. It also shows the average daily gain, cost of gain per 100 lb., and profit per steer with and without pork. It is seen that the addition of maize silage to a ration of shelled maize, cottonseed meal and clover had very little effect on the gains made by the cattle, whereas when alfalfa hay was substituted for clover hay the difference in gain was marked. Although the additions of maize silage to the ration with clover hay slightly reduced the gain (0.07 lb.), it also reduced the cost of gain by 94 cents per 100 lb. In the ration with alfalfa hay the addition of maize silage both raised the gain (0.29 lb.) and reduced the cost of gain (\$ 2.30 per 100 lb.)

Limited feed of maize v. full feed of maize (Lots 1 and 4). — During the five months of the experiment Lot 1 received a ration of maize silage, clover hay and cottonseed meal, with maize in the following varying amounts daily per steer — 1st month, none; 2nd month, 5 lb.; 3rd month, 7 lb.; 4th month, 8 lb.; 5th month, 9 lb. Lot 4 received a ration of cottonseed meal, clover hay, maize silage, and as much maize as the animals would eat after having been gradually worked on to a full feed.

From the table it is seen that the steers on a limited feed of maize ate larger quantities of both clover hay and silage than those on full feed. The average difference in maize consumption was 4.01 lb. daily throughout the whole period.

The table also shows that the average daily gain per steer was $\frac{1}{10}$ lb. in favour of an unlimited maize supply, but the gain was less economical, costing 84 cents per 100 lb. more than when limited maize was fed. The

Ration	Average daily feed consumed per head, December 1, 1915 to April 29, 1916 (150 days).						
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
	Cottonseed meal, clover hay, maize (limited) + shell maize	Shelled maize, cottonseed meal, clover hay	Shelled maize, cottonseed meal, alfalfa hay	Shelled maize, cottonseed meal, clover hay + maize silage	Shelled maize, clover hay, maize silage + cane molasses	Shelled maize, clover hay, maize silage, molasses feed	Shelled maize, cottonseed meal, alfalfa hay + maize silage
	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Shelled maize	5.80	12.34	12.34	9.81	7.68	7.68	9.57
Cottonseed meal	2.44	2.47	2.42	2.45	2.48	—	2.53
Molasses	—	—	—	—	2.59	—	—
Molasses feed	—	—	—	—	—	5.17	—
Clover hay	3.09	12.67	—	2.04	2.00	1.96	—
Alfalfa hay	—	—	11.97	—	—	—	1.95
Maize silage	33.01	—	—	28.64	32.65	29.54	30.81
Average daily gain: cost of gain and profit per steer.							
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7
Average daily gain	1.92 lb.	2.09 lb.	2.06 lb.	2.35 lb.	2.25 lb.	1.90 lb.	2.35 lb.
Cost of gain per 100 lb.	\$ 10.55	\$ 12.33	\$ 12.23	\$ 9.93	\$ 11.35	\$ 12.73	\$ 9.93
Profit per steer with pork	\$ 9.26	\$ 3.97	\$ 4.09	\$ 12.10	\$ 7.48	\$ 3.16	\$ 12.10
Profit per steer without pork	\$ 14.63	\$ 9.55	\$ 10.59	\$ 17.61	\$ 11.52	\$ 9.24	\$ 17.61

profit from full-fed cattle was \$ 1.66 less than that from those given limited maize.

Clover hay v. alfalfa hay as roughage (Lots 2, 4, 3 and 7) When hay was the only form of roughage the cattle receiving clover ate the same quantity of maize but slightly more hay (0.7 lb. daily) than those receiving alfalfa. When, however, silage was added, those receiving alfalfa ate slightly less grain and hay but more silage than those receiving clover. The average amount of food consumed daily is shown in the table.

When clover or alfalfa were fed as the only roughage there was practically no difference in any of the principal factors influencing profit or loss; the rate and cost of gain were practically the same in each case. When, however, silage was added to the ration the cattle receiving alfalfa hay surpassed those receiving clover hay in every factor except pork production, their rate of gain was more rapid and more economical, their finish was better and the profit per steer higher. It is difficult to account for this marked superiority by the slight difference in the rations consumed; it was more likely due to a difference in the individuality of the cattle, although such a difference was not evident. It is notable that in all the trials comparing the value of clover hay and alfalfa hay with maize silage, the cattle which most nearly replaced hay by silage made the most rapid and economical gains. The average results of this experiment are given in the table.

Cane molasses v. molasses feed (Lots 4, 5 and 6). — The rations fed were composed of shelled maize, cottonseed meal (2.5 lb. daily per 1 000 lb. live weight), maize silage, and clover hay, varied with either cane molasses or molasses feed. If feeds containing molasses improve the appetites of cattle they may clearly be of great value. The table shows the effects of the different rations on the appetites of the cattle. It will be seen that the addition of molasses to the ration increased the appetites of the cattle, the increase being shown more particularly by the amount of silage consumed. The molasses feed was much relished by the animals.

The addition of molasses to the ration increased the rate of gain, whereas when molasses feed was substituted for cottonseed meal the rate of gain was reduced. The addition of molasses made very little difference in the cost of gain, but the use of molasses feed instead of cottonseed meal materially increased this cost. It should be noted that the most efficient ration from the point of view of gain and the finish of the cattle was that composed of shelled maize, cottonseed meal, molasses, clover hay and maize silage, but the most economical ration was that composed of shelled maize, cottonseed meal, clover hay and maize silage.

A detailed financial statement of the experiments is appended to the bulletin.

59 — **Fattening Western Lambs in U. S. A.** — SKINNER, J. H. and KING, F. G., in the *Purdue University Agricultural Experiment Station, Bulletin No. 192*, Vol. XIX, pp. 1-20, Lafayette, September, 1916.

The object of the experiment was to compare the feeding values for fattening lambs of : — 1) clover hay and maize silage alone and in combination : 2) maize silage alone and in combination with dry roughage :

3) clover hay and alfalfa hay; 4) cottonseed meal as a supplement to rations of maize, clover hay and maize silage; 5) cottonseed meal and ground soy beans as supplements to rations; 6) molasses. The influence of shelter on fattening lambs was also studied.

Two hundred and twenty-five choice improved Mexican lambs were used. They were of excellent quality and remarkably uniform in size, type, quality and condition. The lambs were divided into 9 lots of 25 each. Eight of these lots were placed in an open shed and fed different rations, the ninth lot was fed in a barn upon a ration similar to that of Lot 6 in the open shed. The experiment lasted 100 days.

Maize silage and clover hay (Lots 3 and 6). — Both lots of lambs were started with a ration of 14 lb. of oats daily for 25 lambs. At the end of the 7th day maize was added to the ration and oats gradually eliminated till by the 17th day, each lot was receiving the experimental rations only. It was only after the 17th day that more than 1 lb. of silage daily per lamb was consumed, but at no time was less than 1 lb. of hay eaten daily per lamb. The appended table shows the results obtained.

It is seen that the difference in daily gain is practically negligible. There was a saving of 81 cents in the cost of 100 lb. gain when silage was used, and an increased profit of 29 cents per head.

Maize silage v. maize silage and dry roughage (Lots 1, 5, and 7). — All the lambs received a grain ration of 7 parts shelled maize and 1 part cottonseed meal. At the end of 80 days, the lambs of Lot 1, receiving only silage as roughage, went off very badly and their ration had to be materially reduced and one feed of clover hay given to make them eat well again.

The table shows that the elimination of dry roughage from the ration decreased the grain consumption and increased the silage consumption, but not in proportion to the dry matter removed by the elimination of clover hay. The elimination of clover hay also decreased the profit per lamb and the rate of gain. The rate of gain and profit per lamb was lowest when oat straw was added to the silage. The finish on the lambs was much the best when clover hay and silage were fed.

Clover hay v. alfalfa hay (Lots 3 and 4). — The only difference in the rations fed was that one lot received clover hay, the other alfalfa hay. It will be seen from the Table that the grain consumed was the same in both cases, but that more hay was eaten when clover was fed. The best results however, as regards gain, profit and finish, were obtained with alfalfa. These results do not agree with two similar trials made at Purdue; this is probably due to the fact that, though the best clover hay procurable was used, it was only of medium quality and not entirely free from mould, whereas the alfalfa hay was of excellent quality and well cured.

Cottonseed meal as a supplement (Lots 6 and 7). — At the end of 12 days 1 lb. of cottonseed meal for 25 lambs was introduced into the ration, and gradually increased till, at the end of 20 days Lot 7 was receiving 3 lb. of cottonseed meal and 21 lb. of maize, as compared with 24 lb. of maize given to Lot 6. Both lots were then given all the grain, hay, and silage they would eat, the cottonseed meal being kept in the proportion of 1 lb. to 7 lb. of

maize. At no time was there any difference in the quantity of food eaten by the two lots. The table shows that, though the addition of cottonseed meal to the ration increased the cost, it also increased the rate of gain and the profit. This is in accordance with previous trials which showed the greatest merit of cottonseed meal to lie in the improved finish it gave the lambs.

Molasses (Lots 2 and 7). — The only difference in the rations of the two lots was that Lot 2 was given 4 lb. of cane molasses daily in place of 4 lb. of maize. The amount of food eaten was almost the same in both lots, though the addition of molasses slightly increased the appetite of the lambs. The rate of gain was slightly higher when molasses was fed, but, owing to the high price of the molasses, the profit was less; this was also partly due to the fact that the finish on the lambs in Lot 2 was less good than those on Lot 7.

Ground soybeans v. cottonseed meal as a supplement (Lots 7 and 8) — The only difference in the rations was the substitution of ground soybeans for cottonseed meal. The table shows the daily food consumption to be practically the same in both cases. The small difference in the rate of gain, the cost of gain and the profit made were in favour of cottonseed meal.

Open shed v. barn as shelter (Lots 6 and 9). — Lot 6 was fed in an open shed containing a space 14 × 16 ft. under cover and 14 × 14 ft. in the open. Lot 9 was fed in a barn 36 × 44 ft. with three windows in the north, one in the south, and one in the east, all of which were kept open. The lambs, the only animals in the barn, were confined in a space of 14 × 24 ft.

Both lots were fed similar rations composed of shelled maize, clover hay, and maize silage. The results given in the appended table show that the grain and hay consumed was the same in both cases, but that Lot 6 ate more silage. This was because the lambs in the barn did not eat silage as early as those in the open; when they had learnt to eat it well, the amount consumed was about equal in both lots. The lambs in the open shed made more rapid and economical gains than those in the barn, but the finish was the same in both cases. These results confirm those obtained in previous trials.

	Lot I	Lot II	Lot III	Lot IV	Lot V	Lot VI	Lot VII	Lot VIII	Lot IX
Combinations of feeds	Shelled maize, cottonseed meal, maize silage.	Shelled maize, cottonseed meal, clover hay, maize silage, cane molasses.	Shelled maize, clover hay.	Shelled maize, alfalfa hay.	Shelled maize, cottonseed meal, clover hay, maize silage.	Shelled maize, clover hay, maize silage (open shed).	Shelled maize, cottonseed meal, clover hay + maize silage.	Shelled maize, clover hay, maize silage, ground soybeans.	Shelled maize, clover hay, maize silage (Barn).
Average daily gain lb.	0.175	0.256	0.24	0.26	0.172	0.247	0.252	0.243	0.239
Average daily feed:									
grain lb.	0.96	1.02	1.01	1.01	1.00	1.01	1.01	1.01	1.01
hay lb.	0.10	1.19	1.82	1.70	0.63	1.17	1.17	1.16	1.17
silage lb.	1.88	1.12	—	—	1.27	1.12	1.12	1.12	1.09
Cost per 100 lb. gain \$	8.86	8.49	8.81	7.87	9.11	8.00	8.26	8.52	8.27
Profit per lamb . . \$	0.80	1.29	1.02	1.74	0.46	1.31	1.74	1.45	1.22

670 - **The Wintering of Bees in Ontario, Canada.** — PETTIT, MORLEY, in *Ontario Department of Agriculture, Bulletin* No. 256, pp. 24 + 11 Figs. Toronto, Ontario, October, 1917.

The beekeepers of Ontario lose each year from 10 to 50 % of their colonies through winter and spring losses.

American bee literature is full of theories on the wintering of bees and on the causes of the losses therefrom. Many of these theories have been rejected or ignored. As the result of numerous experiments and a free interchange of ideas, however, successful beekeepers have evolved methods of wintering based on principles which recent scientific research has on the whole proved to be correct.

Beekeepers in Ontario adopt two methods of wintering. Some place their hives in a cellar and attempt to keep the bees inactive by controlling the environmental factors, such as light, temperature, ventilation, etc., till the weather permits the bees to renew their summer activities. Others protect the hives on the summer stands, leaving the bees free to go out and to fly whenever the weather permits them to do so. Both of these methods, if intelligently carried out, give good results.

For outdoor wintering the hives are placed in collapsible wooden boxes the sides of which are joined by cleats. Many beekeepers place one hive in each box, others two and others four per box. In this last case two hives are placed facing west and the two others facing east. Between the box and the hive is a space of 3 inches, and between the roof of the hive and that of the box a space of 8 or 10 inches is left. The box is placed on a solid stand 8 inches high which prevents draught of air underneath.

The entrance holes are cut in the side of the box so that the bees may go out in suitable weather. The hives are packed for winter as soon as possible after the supers have been removed, and in October the bees are given an abundant supply of maple sugar. The author gives the measurements of the different parts used for constructing wintering boxes, the size of which depends on that of the hives.

Till a few years ago the most common method of wintering in northern climates was that of keeping the hives in a cellar. Most beekeepers in Ontario and the northern States found that their bees wintered better in cellars than out of doors. Since the improvement of the method described above, however, outside wintering is generally preferred even as far north as New Ontario. Nevertheless, many still prefer cellar wintering. The general conditions required for cellar wintering are:— 1) total darkness, 2) uniform temperature between 40° to 45°F. The conditions are obtained most satisfactorily in cellars which are almost entirely underground as they are less subject to changes in outside temperature. The air of the cellar must be kept pure by a suitable system of ventilation, and must be neither too dry nor too damp.

The hives themselves must have good ventilation; this may be obtained by removing the summer covers and placing on the top a layer of felt, cushion of chaff, etc. The hives are placed one above the other, those in the bottom row resting on a stand at least 1 foot above the cellar floor.

The hives are placed in the cellar before the frosts, in southern Ontario in the last days of November, and earlier in the northern districts.

Judgement must be exercised in the removal of the hives from the cellar, the date depending on the condition of the bees and on the season. The best time for setting them out is the evening before or the morning of a day which promises to be fine and calm, but not too hot (60 to 70°F.) When such a day is expected the doors and windows of the cellar are opened at sunset.

Directions are given for the protection of the hives in spring and for feeding the bees. There should be an ample supply of food to avoid any danger of starvation. Autumn is the best time for feeding bees for the following spring.

671 - Bottini, Colantoni, "Subalpina", and "Sughera" Bee Hives. — *L'Apicoltura italiana*, Year XIV, No. 3, pp. 29-31 + 1 Fig. Ancona, March, 1918.

The BOTTINI hive is made of cement with an "Eternit" cover. The cement is mixed with ingredients which make it a bad conductor of heat so that the bees may be protected from cold in winter as much as possible; this would not be the case with ordinary cement. It has the advantage of lasting for a very long time and of being easy to disinfect thoroughly.

The COLANTONI hive only has one medium-sized frame. It combines the advantages of the hive with a moveable top with those of the hive opening at the back. The frame has an opening $9 \times 13 \frac{3}{4}$ inches and may be used both as a brood box and a super. The brood box, which has an opening at the back fitted with glass, makes it possible to estimate the number of young bees, clean the floor easily by raising the shelf, and to place a feeder on the floor. The brood box may even be examined if the super is left in place and the shelves be removed with tongs so long as they are parallel to the entrance.

The "Subalpina" hive, which is an improved DADANT BLATT pattern, includes the following parts: — 1) a floor board on two slide-bars which support, at a height of about 16 inches, four strong legs, slanting and hinged in front. At the back there is a movable ledge (which is fixed temporarily when the hives are moved) which closes the opening between the bottom and the brood box. This ledge is used to clean the hive, introduce disinfectants, queens, etc., for transferring, feeding, etc.; 2) a brood box and super, surrounded at the top by a band which serves as a holder and support to the roof; 3) a floor in two or three pieces, the largest of which is double-walled and forms a very practical feeder; it is composed of two cups for the honey or syrup and a third in the centre which has a hole allowing the passage of the bees which may be stopped when the feeder does not work; 4) an "Eternit" roof. The brood box and super are fitted with holes for a ventilation regulator. The nest and honey store may be arranged either parallel or perpendicular to the entrance.

The "Sughera" hive is not of a single pattern; the name is used only to designate the material of which it is made (cork crushed and united by a paste insoluble in water, or by tar, which is not injurious to bees and prevents their being attacked by *Tinea* larvae). Any kind of hive may be built with this material (1).

(1) See R. Feb., 1918, No. 192. (F. d. L.)

672 - **The Common Honey Bee as an Agent in Plum Pollination.** — See No. 649 o. this Review.

673 - **Can the Action of Cold Decrease Mortality among Silkworms Suffering from "Flacherie"?** — LOMBARDI, LORENZO P., in *Informazioni seriche*, Year V, No. 2 pp. 19-20. Rome, January 20, 1918.

In the Bulletin No. 1, 1916, of the Agricultural Experiment Station of Crema, an article appeared under the title of "Intestinal Fermentation of the Silkworm", in which it was stated that when silkworms suffering from "flacherie" were subjected to a temperature of 12°C. mortality ceased, and the worms spun their cocoons. The worms were subjected to the low temperature for 48 hours, without food. When replaced in their normal surroundings food was withheld for another six hours.

The author (of the Royal Bacteriological Institute of Portici) was not convinced by these experiments, and in order to verify them, made several tests with silkworms of various breeds.

From the results he concluded that a temporary lowering of the temperature does not definitely improve the condition of silkworms attacked by "flacherie". The disease is only temporarily arrested, and later regains its virulence, causing losses equal on an average to those among the control lots.

674 - **On the Discovery of a Plant Suitable for Feeding Silkworms.** — FUJITA, DAIZO in the *Bulletin de l'Association sericicole du Japon*, Year II, No. 12, pp. 1-16. Tokio, December 25, 1917.

As it is not uncommon in Japan for the young mulberry leaves to suffer from drought and frost the author has sought for plants suitable for feeding silkworms while resisting frost (other than *Cudrania triloba* [silkworm thorn]; *Broussonetia Kazinoki* Sieb., black goat's-beard, dandelion, plants already known to be utilisable for this purpose).

The author lists 13 plants that seem to be eaten readily by the silk worm; he has classified them according to his experimental results in the following manner:

a) Plants of no practical value:— 1) *Phragmites communis* Trin.
2) *Lactuca Thunbergii* Maxim; 3) *Campaunla punctata* Mig.; 4) *Lampisana apogonoides* Maxim.; 5) *Lampsana humilis* Makino; 6) *Crepis japonica* Benth; 7) *Pieris hieracioides* L. var. *japonica* Bgl.

These plants might furnish good food but their leaves are too scanty.

b) Plants of uncertain practical value:— 8) *Lactuca denticulata* Maxim; 9) *Codonopsis lanceolata* B. and H.; 10) *Papaver somniferum*.

c) Plants fairly useful for feeding the larvae:— 11) *Sorghum oleraceum* L.; *Adenophora verticillata* Fisch. var. *typica*.

d) A plant worth using:— 12) *Lactuca brevirostris* Champ. (1). This plant starts growing early in spring and by autumn reaches a height of 6 or 7 ft. If it is cut in summer, it puts forth buds and grows rapidly, so that the leaves can be removed continuously from spring to autumn. Silk

(1) See R., January 1918, No. 77. (Ed.).

worms fed on this plant until their first moult and even the second one, gave excellent results, actually better than those given by mulberry-fed larvae. Larvae fed on this plant up to the third moult gave results slightly inferior to the preceding ones; but experience has shown that *L. brevirostris* is perfectly suitable for feeding silkworms.

65 - **Production of Silkworm Eggs of the Annual Breed, in Japan, in 1917.** --- *Informazioni seriche*, Year V, No. 6, pp. 89-90. Rome, March 20, 1918.

According to the Japanese Ministry of Agriculture and Commerce the quantity of silkworm eggs produced in 1917 was estimated at 292 347 533 layings of eggs in frames and 765 050 boxes of commercial eggs, or a total of 3 688 525 boxes (100 layings in frames make a box), an increase of 5 % on the production for 1916.

The seed was produced by the different breeds in the following manner: 1 448 623 boxes of Japanese breeds, or 39.3 % of the total production; 2 239 902 boxes of foreign breeds, or 60.7 %. In the foreign races there were 35 % of yellow cocoons and 40.5 % of white ones. The Sino-European hybrid is the most numerous (58 %) in the eggs giving yellow cocoons; then come the Nippo-European hybrids with 17.7 % and the European races with 11.2 %. Amongst the eggs giving white cocoons, the Sino-Japanese hybrid forms 58.9 %, the Sino-Nippo-Europeans 15.9 % and the Chinese races 19.2 %.

66 - **Development of the Silkworm industry in Cambodia.** -- DE FLACOURT, MARTIN, in *Bulletin Economique de l'Indochine*, Year XX, New Series, No. 127, pp. 649-661. Hanoi-Haiphong, November-December, 1917.

Cambodia has a hot and fairly dry climate and a fertile soil in which the mulberry tree grows remarkably well. Silkworm breeding there is very popular and very widely practised. Information gathered at the silkworm centres, as well as in certain other districts of the country, shows, not only the present possibilities of production, but also a great promise for the future development of the industry. Special attention should, therefore, be given to this country, which is perhaps the only one of French Indo-China combining such conditions so favourable to an assured intensive development of silkworm breeding.

As things are at present its capacity of production makes it possible to consider with confidence a perfected spinning industry which will henceforth be assured of obtaining locally a sufficient quantity of good quality raw material to supply over 500 to 600 pous. The undeniable influence of the industry on the production of the country may be easily foreseen.

On the other hand the local Government, by the action it has exercised so far on the most important silkworm breeding centres and could extend to the other districts of Cambodia, and by the great encouragement it has given to the industry, has favoured and prepared the way for the establishment of steam silk spinning mills, which form the basis of a perfected silk industry, and appear at an eminently favourable moment.

It falls to private initiative and the French consumers to profit by the situation by founding spinning mills and thus contributing to the development of the local silk production

- 677 — **The Raising of Leather-Carp and Black-Bass in Sologne, France.** — ROULE, LOUIS, in the *Bulletin de la Société Nationale d'Acclimatation de France*, Year LXVI, No. 2, pp. 33-35. Paris, February, 1918.

M. BRUNET has carried out successful acclimatisation experiments on his property at Mouteaux, Sologne.

Leather-carp (notable for their rapid growth, hardiness, small bones and good quality flesh) were imported from central Europe some 10 years ago. The acclimatisation was perfect, M. BRUNET has had no need for further importation and he now stocks his ponds with fry of his own rearing.

The black-bass (*Micropterus salmoides* Lac.) has been imported into Europe from the United States. It was known that it could live under French climatic conditions, but it was not certain if it could breed there, as it does in upper Italy. M. BRUNET imported 30 black-bass fry from Italy in April, 1914, and distributed them in his ponds; they were taken out in October 1914 and gave not only fine young fish weighing about 2.2 lbs., but also about 4,000 fry. The black-bass had reproduced, therefore, and were completely acclimatised.

FARM ENGINEERING.

- 678 — **British Agricultural Tractors.** — *The Engineer*, Vol. CXXIV, Nos. 3233, 3234, 3235; Vol. CXXV, Nos. 3236, 3237, 3238, 3239, 3240, 3241, 51 Fig. London, December 14, 1917-February 8, 1918.

According to the President of the Board of Agriculture, 1,400 tractors had, by October 6, 1917, ploughed 14,500 acres of land for next year's harvest. Three years ago there were probably not 100 tractors in use in the United Kingdom. This progress, though considerable, has not been as rapid as it might have been owing to the objections raised by farmers against mechanical traction chiefly with regard to compressing the soil and the provision of inadequate power. In some recent models the latter defect is obviated by providing a 30 HP. engine which should suffice for 3-furrow ploughs doing fairly deep work under favourable circumstances. British tractors are usually strongly built, and they are therefore very lasting. In time standardisation will be probably arrived at in the various types of tractor but the final type has not yet been decided upon. There are still numerous problems that remain to be solved by British makers, who are at present occupied in delivering the machines that are required for bringing large areas under cultivation.

British agricultural tractors may be divided into 2 classes, those that are propelled by *a*) steam and *b*) by internal combustion engines. Contrary to the internal combustion engined machines, the steam driven ones follow save in one or two cases, very closely the design of road locomotives, except they are lighter, the question of weight being of great importance.

STEAM TRACTORS. — The agricultural tractor made by AVELING & PORTER, of Rochester (fig. 1) resembles the road locomotives and rollers made by that firm, but it is smaller and lighter (5 tons). The driving wheels, which

e 5 ft. in diameter, are 12 in wide, but for working on soft ground detachable tension rings 6 in wide with the necessary spuds are provided.

The engine is of the compound type with 2 cylinders. The boiler has 27 tubes and is fitted with a fire-box of the Belpaire type. The normal speed of the engine is 225 revolutions per minute, and at that speed 21 brake-h.p. developed at the fly-wheel. The engine is mounted on laminated steel rings fitted to both back and front axles. There are 2 speeds: — 2 $\frac{1}{2}$ and 5 miles per hour respectively.

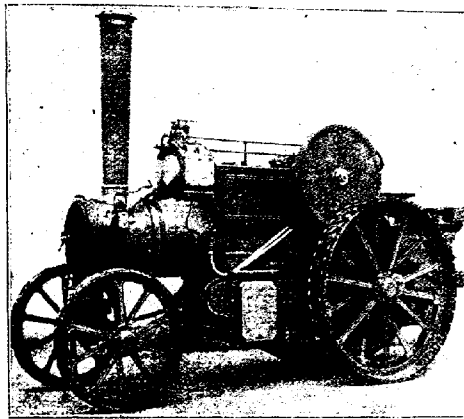


Fig. 1. — AVELING & PORTER steam tractor.

This serviceable little engine will haul a 3-furrow plough under normal conditions. It can cover from 40 to 50 miles per day on the road, with an approximate cost of from 15s. to 16s. Coal, or more preferably coke, is the fuel employed.

The tractor (fig. 2.) built by C. BURRELL & SONS, of Thetford, has an overall length of 14 ft. 3 in., a width of 5 ft. 8 in., and a height to the top of the fly-wheel of 6 ft. 8 in.; it weighs 6 tons 18 cwt. The boiler is of the locomotive type and has 25 tubes. The engine is compound with cylinders 4 $\frac{1}{2}$ in. and 7 $\frac{1}{2}$ in. in diameter by 8 $\frac{1}{2}$ in. stroke. It runs at 230 revolutions per minute, developing 20 B. H. P. at the fly-wheel. It has either 2 or 3 speeds; the 3 speeds being 2, 3 and 5 miles per hour. The tractor is furnished with a winding drum which is operated by the engine and carries 60 yards of steel wire rope. It is specially built for farm work.

Amongst the various engines built by W. FOSTER & CO., of Lincoln, the 1909 model of the "Wellington" tractor, shown in Fig. 3, may be referred to.

The tractor is of 14-18 H.P., very well built and designed, and can tow

an 8-ton load over good roads with gradients up to 1 in 20, while on the slow speed gear it will haul the same load up gradients of 1 in 8. The tender contains a water tank of 80 gall. capacity and a coal bunker holding $3\frac{1}{2}$ cwt.

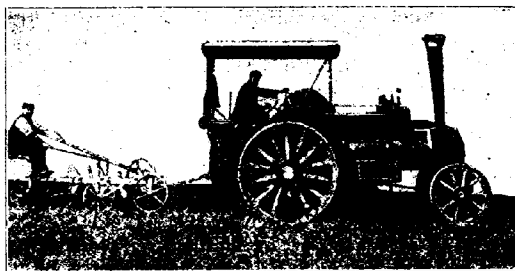


Fig. 2. — BURRELL & SONS steam tractor.

Additional tanks are fitted that bring up the total water capacity to 150 gall., which suffices for a journey of some 18 miles under normal conditions.

It is possible that, on account of the limitations of weight, the machine

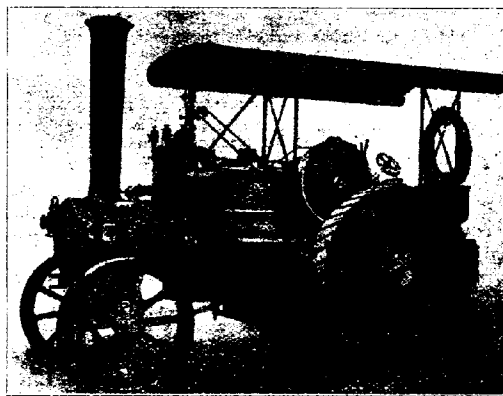


Fig. 3. — "Wellington" steam tractor (W. FOSTER & CO.)

requires replenishing with coal and water too frequently to suit farming conditions; the tractor has, however, been successfully used for hauling 3-furrow ploughs.

The same firm also builds a larger steam tractor, specially designed to

in agricultural conditions in the Argentine. The boiler is designed for turning straw; it will haul a plough, serve as a road tractor or drive a FOSTER threshing machine. The firm of FOSTER also builds a 40 B. H.P. petrol tractor for use as a general purpose machine. It weighs about $4\frac{3}{4}$ tons and gives an effective draw-bar pull of 4 000 lb.

The "Suffolk Punch" steam tractor built by R. GARRETT & SONS, of Kingston, is of the horizontal compound type (1). It is intended to perform any agricultural work (Fig. 4) as well as hauling a 10-ton load at 5 miles an hour over fairly good roads. The fire-box is placed in the front of the motor, while the smoke-box and funnel are in the rear, so that the driver is very well placed for controlling the vehicle. The boiler is designed so that an inferior quality of coal may be used; the steam is superheated. The engine develops from 37 to 40 B. H. P.

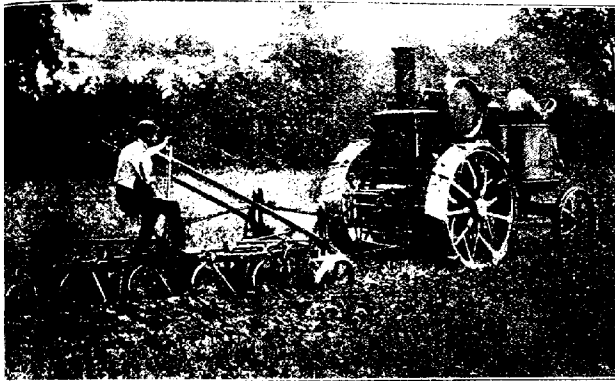


Fig. 4. — "Suffolk Punch" steam tractor (R. GARRETT & SONS) drawing a plough.

According to the makers, the average cost of hauling a 4-furrow plough, ploughing to a depth of 6 in. to 7 in., is from 3s. 6d. to 4d. 6d. per hour, the time taken being from $1\frac{1}{2}$ to 2 hours per acre.

The engine normally runs at 325 revolutions per minute, and there are 2 speeds, namely, a slow speed of 2 miles per hour for ploughing and a higher speed of 5 miles for road work, the engine running at normal speed in both cases. The tractor in full working order weighs about $5\frac{1}{2}$ tons.

The MANN'S PATENT STEAM CART AND WAGON CO., of Leeds, have designed a tractor specially for farm and estate work. This tractor (Fig. 5) has 3 speeds, varying from 2 to 6 miles per hour. The lowest speed is for ploughing in strong land; the intermediate speed for light or medium

(1) See R., 1916, No 331. (Ed.)

land, as well as for pulling self-binders, etc., and the quick speed for travelling on the road.

The engine is of the horizontal type, with cylinders 4 in. and $6\frac{3}{8}$ in. in diameter by 7 in. stroke. The governor is set to run the engine at 300 revolutions per minute, the speed required for driving ordinary threshing machines. The tractor itself weighs about $4\frac{1}{4}$ tons, but detachable side boards are provided so that an extra weight of about a ton can be carried for road work.

On ordinary roads this tractor can haul a 6-ton load; it will easily pull a 4-furrow plough in strong clay land. A fair average days' ploughing is 5 acres.



Fig. 5. — MANN steam tractor, drawing a plough.

In the tractor made by Messrs. J. and H. McLAREN, of Leeds (illustrated in Fig. 6), the boiler is of the usual traction engine type, with a compound engine, with cylinders $4\frac{1}{2}$ in. and $7\frac{1}{2}$ in. diameter by $8\frac{1}{2}$ in. stroke. There are 3 speeds, namely, 5, $2\frac{1}{2}$ and 2 miles per hour. When running on the road at 5 miles per hour the speed is 314 revolutions per minute, but when ploughing at 2 miles per hour, the speed is 355 revolutions per minute. The machine weighs under 5 tons and is built so as to have a long life. This tractor, provided with a trailer, gained the Royal Agricultural Society's Gold Medal in 1910.

The compound steam tractor made by RANSOMES, SIMS AND JEFFERIES, of Ipswich, weighs about $4\frac{3}{4}$ tons. It is of the road locomotive type and is more especially intended for hauling loads of from 5 to 7 tons on ordinary roads with moderate gradients than for ploughing and similar farm work. The high-pressure cylinder is $4\frac{1}{2}$ in. in diameter and the low-pres
[618]

sure cylinder $7\frac{1}{2}$ in. in diameter, the stroke of both cylinders being 8 in. A by-pass is provided so that high-pressure steam can be admitted to the low-pressure cylinder to provide increased power for starting or emergencies. The engine develops 16-20 H.P. For travelling, 2 speeds, namely, 3 and 5 miles per hour, are provided. The engine is mounted on helical springs to the main axle and laminated springs to the front axle.

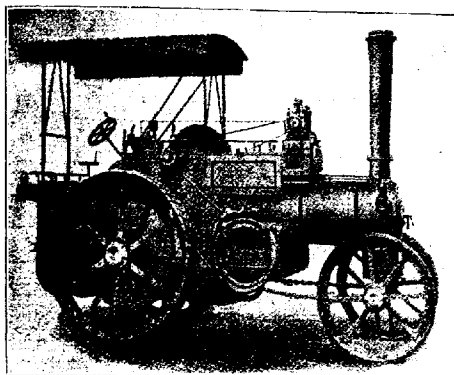


Fig. 6. — MACLAREN steam tractor.

The tractor made by ROBEY & CO. of Lincoln, can haul from 6 to 8 tons on ordinary roads, plough from 10 to 15 acres of average land per day of 10 hours and will drive such machinery as a 4 ft. 6 in. threshing machine.

It is of the usual road locomotive type, but in miniature (Fig. 7). The engine is compound with cylinders 5 in. and 8 in. in diameter by 9 in. stroke. There are 2 travelling speeds, *i. e.*, $2\frac{1}{2}$ and 5 miles per hour.

It is impossible to give any exact figures as to costs of working these tractors, but approximately it may be said that, taking coal at £2 per ton, the total cost (wages, fuel, oil, interest, etc.) of ploughing 60 acres in 5 days of 10 hours each is £12. 5. 6, the acre, therefore, costing 4s. $1\frac{1}{2}$ d. per acre.

W. TASKER & SONS, of Andover, make a series of tractors specially designed for agricultural work. The most important model (Fig. 8) — the "Little Giant" — is a gear-driven steam tractor; another type is chain driven. Another type has a winding drum for double engine ploughing.

These machines are of the road locomotive type. The engine is of the compound type with cylinders 5 in. and $7\frac{3}{4}$ in. in diameter by 8 in. stroke, and develops 25 B. H.P. When the machine is to be used for driving fixed machinery, a high-speed governor of the Pickering type is provided. There are 2 speeds, *i. e.*, 3 and 6 miles an hour. The main gearing runs in an oil bath. The mounting is on the Hoare's spring system.

WALLIS & STEEVENS, of Basingstoke, make the "Wallis" steam motor tractor for universal service. The model (Fig. 9) has been greatly perfected since it was first produced in 1900. It can haul a 6-furrow plough in most soils, and on medium land as many as 9 furrows have been cut with it.

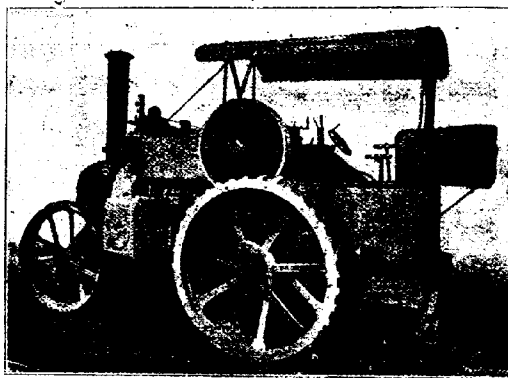


Fig. 7. — ROBEY & Co steam tractor.

The tractor has a locomotive-type boiler with the 2-cylinder engine mounted on top of it. When running at its normal speed of 400 revolutions per minute it develops 24 B. H.P. The working parts are enclosed in a

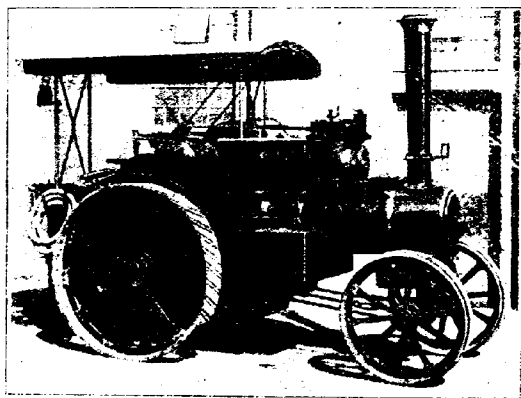


Fig. 8. — "Little Giant" steam tractor (W. TASKER & SONS).

splash oil-bath, and are therefore protected from dirt and dust, while being easily accessible to the driver. Gear changing is easy and the main axle is fitted with a differential motion. The hind axle is fitted with a slip-winding drum. The tender contains a coal bunker and a water tank. The tractor burns coal or coke, but wood may be used.

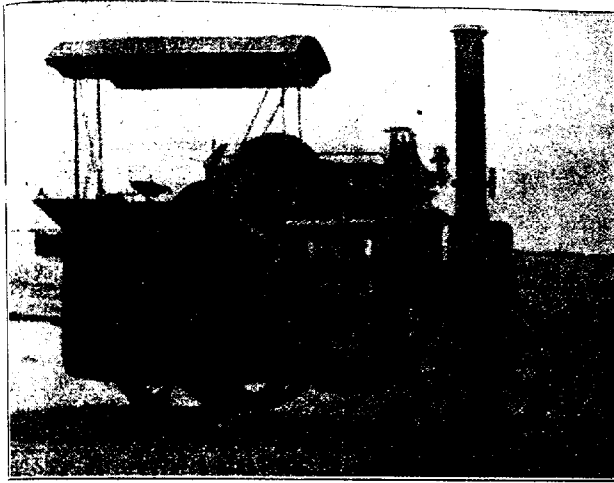


Fig. 9. — WALLIS & STEEVENS steam tractor.

According to the makers the cost of ploughing an acre works out at just under 11s., while the machine can plough 5 acres a day on the average.

INTERNAL COMBUSTION TRACTORS. — BUMSTED & CHANDLER, of Hednesford, Staffordshire, make the "Ideal" (1) tractor (Fig. 10) for general farm use: — ploughing, harvesting, road hauling, and as a power plant.

It is driven by a vertical 4-cylinder engine, which develops 35 HP. There are 2 speeds forward of 3 and 6 miles per hour and a reverse speed of 3 miles per hour. The hind wheels are furnished with self-cleaning spuds. With a 4-furrow plough, the machine weighs 4 $\frac{1}{2}$ tons. It is 20 ft. long, with the plough attached, and 6 ft. 6 in wide. On average land it ploughs one acre per hour.

A long and interesting description is given of the Crawley "Agrimotor", which has been dealt with previously (2).

Motor ploughs of two sizes are built by J. FOWLER & Co., of Leeds. In one the engine has a single cylinder, while in the other there are 2 cylinders.

(1) See B., 1914, No. 558. (Ed.) — (2) See R. 1917, No. 942. (Ed.)

These machines embody the Wyles' patents and also the subsequent inventions and improvements of J. FOWLER & Co. The first type, of 10 HP. (1) can do the work of 4 horses and is very suitable for work among drilled crops vineyards, hop gardens, colonial crops, etc.

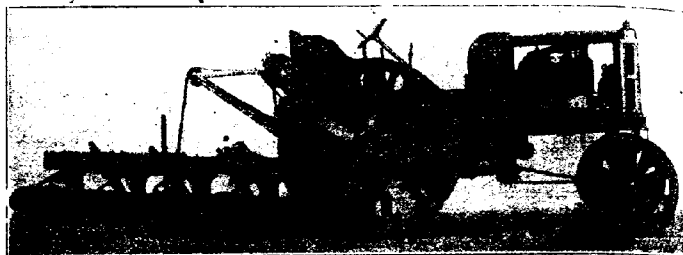


Fig. 10. — BUMSTEAD & CHANDLER motor tractor, hauling a plough.

The 2 cylinder plough (Fig. 11) with a single speed of $1\frac{3}{4}$ miles per hour weighs about 21 cwt. It can be fitted with 2 forward speeds of 2.2 and 1.2 miles per hour respectively, and a reverse speed of 1.5 miles per hour. It is slightly longer and wider than the single-cylinder machine.



Fig. 11. — JOHN FOWLER & Co. motor plough.

Its cylinders have a 4 in. bore and 5 in. stroke; it develops 13-14 B. H.P. with the engine running at from 1 000 to 1 100 revolutions per minute.

It can either cut one or two furrows; if 2, the width and depth cut slightly less.

(1) See R., 1916, No. 897. (Ed.)

The "Ivel-Hart" tractor, built by the IVEL AGRICULTURAL MOTORS, Limited, is driven by an engine which will work with paraffin, petroleum and other low grade fuels, after starting on petrol. One of its chief features is (Fig. 12) that it only has one driving wheel, and hence differential gearing is not required.



Fig. 12. — "Ivel Hart" motor tractor, drawing a plough.

The engine is of 2-cylinders, cast in one piece, with $5\frac{1}{2}$ in. bore and 7 in. stroke, and the normal speed is 600 revolutions per minute (varying from 500-750). At the normal speed the brake horse-power is 22, and the draw-bar horse-power 15. There are 2 forward and 2 reverse speeds, obtained by a total of 7 gear wheels and pinions, 5 of which run in an oil bath. Lubrication is of the force feed type. The total weight is 50 cwt. and the length is 12 ft. 8 in.

The machine is self-steering when ploughing. The draw-bar can be adjusted in position. Under average conditions the tractor can haul a 3-furrow plough at a depth of from 6 in. to 8 in., while in heavy soils it will haul a 2-furrow plough cutting from 6 in. to 10 in. deep. It will plough an acre with a 3-furrow plough to a depth of from 6 in. to 7 in. in from $1\frac{3}{4}$ to $2\frac{1}{4}$ hours, depending on the nature of the soil and the length of the field. To plough an acre takes from 4 to 5 gallons of paraffin according to the soil.

The motor plough made by MARTIN'S CULTIVATOR COMPANY, Limited, of Stamford, is of the caterpillar type. It is a 3-furrow plough (Fig. 13) and

does all the work that can be done by horse ploughing ; it can be manipulated by one man.

It can plough 5 or 6 acres a day with a consumption of $2\frac{1}{4}$ to 3 gall. of petrol. The whole of the plough frame can be detached and its place taken by a wheeled undercarriage, the machine then becoming an agricultural tractor suitable for working cultivators, drills, harrows, mowers, etc. A pulley for driving machinery can also be attached.



Fig. 13. — MARTIN motor tractor, drawing a plough.

The engine is of the 4-cylinder, 4-cycle type, similar to that used in heavy motor lorries. The cylinders have a bore of $3\frac{3}{4}$ in and a stroke of 5 in. At 1000 revolutions per minute the engine develops 25 B.H.P. There are 2 "Zenith" carburetters. The engine is started on petrol and run on paraffin. There is a Dixie magneto and lubrication is effected by a gear-driven wheel pump.

The chain tracks are constructed in accordance with recent patents. Each can be separately adjusted so as to act as land or furrow wheels respectively and also to regulate the depth of ploughing. They distribute the weight over a large area of soil, and since the total weight of the motor with a 3-furrow plough is only about 30 cwt., the weight per unit of area in contact with the soil is by no means high.

The "Universal" tractor(1), made by the SAUNDERSON TRACTOR AND IMPLEMENT Co, is well known, but the present model (Fig. 14) is much more simple. The makers have paid great attention to the accessibility of the parts, ease of renewals and increase of bearing surfaces to give longer life. Before this improved model was placed on the market it was tested for 12 months on some of the heaviest clay in England. The machine proved itself capable of doing the entire work on a 240-acre farm, no horse labour what ever being required.

(1) See *B.*, 1914, No. 558, and *R.*, 1916, No. 897. (*Ed.*)

The "Universal" tractor is of 20-25 B.H.P. It can haul a 3 or 4-furrow plough or other implement, and drive a 4 ft. 6 in. thresher with elevator and chaff-cutter attached. It will haul 5 or 6 tons on the road at a speed of 5 miles per hour. By means of a special coupling it can haul 3 mowing machines, or 2 self-lift binders.

All the working part of the tractor are covered in; the control mechanism is very simple: the movement of one single lever in front of the driver forwards or backwards controls everything by acting on the governors. The tractor is completely standardised, so that the firm will soon be producing a large number of these British-built machines.

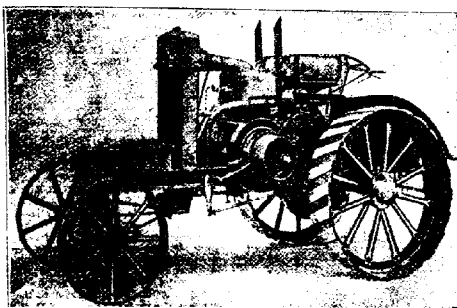


Fig. 11. — SAUNDERSON TRACTOR AND IMPLEMENT CO. motor plough.

With the object of providing an equipment less costly than the usual team plant, WALSH & CLARK, of Guisely, near Leeds, make a ploughing set operating on the cable system, but driven by internal combustion engines, which are started on petrol but run on paraffin. Each engine (Fig. 15) weighs about 6 tons, and is rated at from 30 to 55 B.H.P. at an engine speed of 600 revolutions per minute, and when travelling or ploughing, and 22 B.H.P. on the driving belt.

The engine is of the horizontal type, with 2 cylinders, and gives a continuous pull on the rope of 3500 lb. It will haul a 4-furrow plough on medium or light land, and a 3-furrow plough on heavy land. A pair of engines can plough from 7 to 10 acres per day of 10 hours, according to the nature of the land, and with rope speeds of from 250 ft. to 350 ft. per minute. They will also cultivate from 14 to 20 acres per day. The machine can be employed as a tractor for road or field work.

Messrs. W. WEEKS & SON, of Maidstone, make the WEEKS DUNGEY "New Simplex" tractor (Fig. 16), intended for all-round farm work. It starts on petrol, but runs on paraffin; there are 3 speeds, *i. e.*, $4\frac{1}{2}$, $2\frac{1}{2}$ and $1\frac{3}{4}$ miles per hour. It has cut 24 acres of corn per day with an ordinary 5 ft. binder, and 27 acres with a 6 ft. machine.

The "New Simplex" tractor has 4 wheels and weighs 35 cwt. It is .8 ft. long, 4 ft. wide and 5 ft. 6 in. high and develops 25 B.H.P.



Fig. 15. -- WALSH & CLARK cable motor tractor.

The machine is very well constructed and fitted with all the latest improvements. In Kent, it has ploughed from $2\frac{1}{2}$ to 3 acres per day, at a cost of about 12s. per acre.

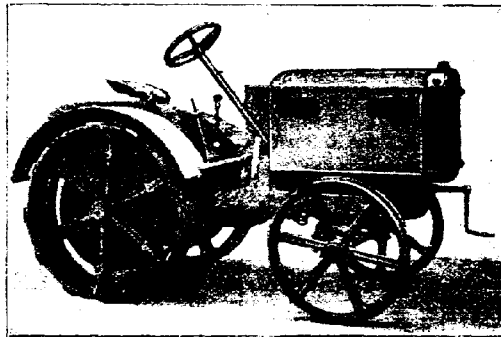


Fig. 16. -- "New Simplex" motor tractor (W. WEEKS & SONS).

The WYLES motor plough has been described in this *Review*, March 1918, No. 332. Fig. 17 shows it hauling a mowing machine.

The latest tractor built by Messrs. CLAYTON & SHUTTLEWORTH, of Lincoln, is of the chain track type, and a woman can manipulate it, with a

plough attached. The tractor develops 35 HP and it can haul a 3- or 4-furrow plough.

The engine has 4 cylinders, each of 120 mm. bore and 140 mm. stroke. Petrol is used for starting and paraffin for running. The mechanism is easily accessible. Two forward speeds of $1\frac{3}{4}$ and 4 miles per hour and a reverse of 3 miles per hour are provided, while the necessary mechanism is actuated by straight-through lever control. The chain tracks have received a good deal of attention. The weight of the tractor is carried on each side by 4 rollers.

The draw-bar pull is 2 tons in slow gear. For the driving of machinery there is a belt pulley. The tractor weighs 2 tons 16 cwt. It is 11 ft. long, 5 ft. 4 in. wide and 5 ft. 6 in. high. The British Government has ordered large numbers of these tractors.



Fig. 17. — WYLES m-tor tractor, hauling a plough.

The ALLDAYS & ONIONS PNEUMATIC ENGINEERING CO. make a tractor carried on special springs for road work, the springs being clamped down for field work.

Fig. 18, shows the tractor, which is for all-round work. It has 3 speeds forward and a reverse; the highest road speed is 5 miles per hour and the low speed is $1\frac{1}{2}$ miles per hour for difficult ploughing and $2\frac{1}{2}$ for ordinary ploughing.

The engine is vertical, 4-cylinder, and runs at 1000 revolutions per minute. A Zenith carburettor, arranged to work with paraffin is provided.

The crank shaft is carried in 3 bearings lined with anti-friction metal. There is a high-tension Dixie magneto, and steering is by the Ackermann system. The tractor will turn in a circle having a diameter of 28 ft. It is provided with a winding drum, carrying 50 yards of steel wire rope. The present wheel base of the tractor is 7 ft. 10 in., but it is to be reduced to 7 ft.

The tractor has been tested in Scotland and also at Birmingham where it drew a 3-furrow HOWARD gang plough. The draw-bar pull was about 1100 lb. on the average.

For use in driving machinery, an 18 in. pulley is provided; it can drive a 4 ft. 6 in. threshing machine.

Besides the detailed description of the various British tractors, an account is given of the "Tracford" (1) appliance, intended to convert a FORD or other car into a 20 HP agricultural tractor. There are 3 steel land wheels, provided with detachable spuds.

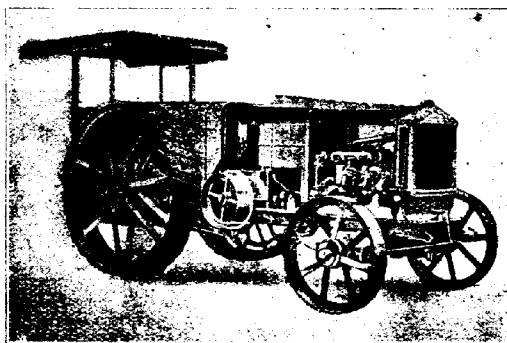


Fig. 18. — ALLDAYS & ONIONS motor tractor.

679 - **Ploughing with Government Tractors in England.** — *Mark Lane Express Agricultural Journal*, Vol. CNIX, No. 4507, p. 141, and No. 4510, p. 228. London, February 11 and March 4, 1918.

In Herefordshire, 3 "Titan" tractor units ploughed over 520 acres in the last week of January, the division being: Hereford, 170 acres; Leominster, 142 acres, and Ross, 208 acres.

The Ross team's work, which was accomplished with 7 tractors, gave an average of $29\frac{5}{7}$ acres per tractor; 9 tractors were used in the Hereford and Leominster units, which makes the work done by the Ross unit all the more creditable; the work done by the Ross tractors varied from 26 to 3 acres each, ploughed in from 53 to 68 $\frac{1}{2}$ hours.

(1) See *R.*, April 1918, No. 455. (*Ed.*)

In Surrey, a Titan tractor ploughed 51 acres in a single week at Redhill. The county average for the week was 12 acres per tractor.

In Lancashire a tractor towing a 3-furrow RANSOME plough did $52 \frac{1}{4}$ acres during the week ended February 23. No special provision was made for record breaking. The ploughing was 8 in. deep and 2.54 gallons of fuel were consumed per acre.

In 5 weeks this tractor has performed the following work (including that described above):—during the week ended January 25, $27 \frac{1}{2}$ acres were ploughed, 103 gall. of fuel; from January 25 to February 15, 21 acres were ploughed on an average per week, with an average consumption of 66 gall. of paraffin; the total consumption for the week February 15 to 22 for ploughing $52 \frac{1}{4}$ acres was 133 gallons.

19 — **The Use of Coal Gas for Ploughing Tractors.** — *The Implement and Machinery Review*, Vol. XLIII, No. 516, p. 1589 + 2 Figs. London, A, 311, 1918.

As petrol is unobtainable and paraffin is both scarce and costly, it is of interest to note the use of coal gas for ploughing tractors.

Messrs. BARRON BROS. of Beeston, England, make a flexible gas container to be placed above the tractor. This system, already adopted for many commercial and pleasure vehicles, is the most economical as it does not require the gas to be compressed and only gives a slight loss in calorific efficiency. For farm work there is no objection to the use of a container, save that of its voluminous appearance. It is carried on a tray supported by wooden uprights bolted on to the tractor frame.

The container's capacity is 250 cu. ft., and, it is reported that 500 cu. ft. of gas suffice to plough half an acre of level land.

The system can be employed to advantage by farmers within reasonable distance of a supply station. In England, as the companies usually give special conditions to users of gas for power purposes, the cost of ploughing by this means is very low. In the case mentioned in the article the container is mounted over a Whiting-Bull tractor and the gas is brought to the field in a portable holder carried on a trailer and containing sufficient to charge the bag on the tractor three times, or enough to plough about three-quarters of an acre. To the cost of the gas must, therefore, be added the expense of the journeys with trailer between the field and the supply station.

The distance over which the owner can afford to transport the gas will probably be found to be fairly large considering the present price of other fuels.

20 — **Ridger for Making Irrigation Levees.** — See No. 625 of this *Review*.

21 — **Review of Patents.**

TILLAGE MACHINES AND IMPLEMENTS. — *France*: 486337 Fixing device for plough shares and other similar cultivating tools; 486445 Motor plough.

United Kingdom: 113029 Motor driven endless track machine for levelling ground and for extracting steel and iron scrap therefrom in view of reclaiming land.

United States : 1254817 Harrow ; 1254985 Plough coulter ; 1255035 Self cleaning harrow and cultivator ; 1255420 Combined tractor, roller and harrow ; 1255442 Detachable share for cultivator and scarifier implements ; 1255509. One wheel harrow cart ; 1256225 Detachable V shaped packing band for fitting on a harrow-disc ; 1256349 Traction gang plough ; 1256632 Agricultural machine ; 1256984 Disc-plough ; 1257127 - 1257818 Ploughs ; 1257236 Tractor plough ; 1257407 Riding attachment for harrows and the like ; 1257446 Gang plough.

MANURES AND MANURE DISTRIBUTORS. — *United States* : 1255052 Straw-spreader ; 1256190 Spreading machine ; 1256196 Straw conveyor and spreader ; 1256854 Fertilizer distributor ; 1256459 Fertilizer attachment for maize planters.

DRILLS AND SEEDING MACHINES. — *Canada* : 180769 Land packer and seeder.

United Kingdom : 112976 Potato planter.

United States : 1254859 Drill ; 1255055 planter ; 1255532 marker for maize planter ; 1256083 Rotary marker device for actuating the rock shaft of a maize planter ; 1256292 Potato planter ; 1257839 Maize planter ; 1257928 Attachment for maize planter.

VARIOUS CULTURAL OPERATIONS. — *United States* : 1254687 Weeder ; 1254999 Cotton chopper ; 1256473 Cultivator fender.

CONTROL OF DISEASES AND PESTS OF PLANTS. — *France* : 486296 Application of calcium sulphide to the treatment of fungous diseases of the vine and other plants.

United Kingdom : 113121 Reciprocating pump for spraying apparatus.

United States : 1254649 Boll weevil exterminator ; 1255131 Insect destroyer.

REAPERS, MOWERS AND HARVESTING MACHINES. — *France*. 486239 Circular platform harvesting machine with curved cutting knife for various heights.

United Kingdom : 113117 Mechanism of side-delivery rake and swath turning machines.

United States : 1255209 Combined harvester ; 1255365 Hay sweep ; 1255520 Hay rake ; 1255914 Pea picker ; 1255930 Harvester and elevator combined ; 1255982 Harvester-crop curing chamber and baler ; 1256178 Side-delivery rake ; 1256347 Maize harvester ; 1256390 Vegetable gatherer and loader ; 1256410 Bundle carrier attachment for harvester ; 1256438 Vacuum cotton picking machine ; 1256683 - 1247493 Ensilage harvesters ; 1256700 Grass guard for mowers ; 1256776 Corn harvesting attachment for farm wagon ; 1257269 Bean harvester ; 1257304 Adjusting mechanism for grain shocking machine ; 1257386 - 1257387 Mowers.

MACHINES FOR LIFTING ROOT CROPS. — *Switzerland* : 77479 Forkbeak for potato diggers.

United States : 1255051-1256713 Vegetable harvesters ; 1255302 1256182 Potato digging machines ; 1256119 Front auger support and bearing for beet harvester ; 1257081 Beet harvester and topping machine 1257168 - 1257953 Beet harvesters.

THRESHING AND WINNOWER MACHINES. — *Canada*: 181020 Grain grader.

United States: 1254817 - 1257592 - 1257802 Threshing machines; 1256120 - 1256506 Feeders for threshing machines; 1256585 Bean separator; 1257115 Pea and bean separator.

MACHINES AND IMPLEMENTS FOR THE PREPARATION AND STORAGE OF GRAIN, FODDER, ETC. — *Canada*: 181041 Drying kiln.

United States: 1255041 Hay press; 1257466 - 1257474 Bale forming presses; 1257510 Feeding device for hay baling presses.

STEERING AND TRACTION OF AGRICULTURAL MACHINERY. — *Canada*: 181061 Tractor.

France: 486455 Agricultural tractor.

United Kingdom: 113016 Apparatus for power cultivation of land; 113102 Endless track vehicle.

United States: 1254819 Endless automatic track laying and ground treading power operated traction engine; 1255404 - 1255530 - 1256651 Tractors; 1256113 Tractor wheel; 1257416 Tractor or truck; 1257589 Tractor connection.

FEEDING OF LIVESTOCK. — *United States*: 1254937 Hog watering apparatus.

POULTRY FARMING. — *United Kingdom*: 113159 Feeding trough for poultry.

INDUSTRIES DEPENDING ON PLANT PRODUCTS. — *United Kingdom*: 113042 Bakers' oven.

DAIRYING. — *Canada*: 180828-180970 Desiccated milk; 180829-180830 Milk condensation, process and apparatus; 180831 Buttermilk powder; 181131 Milk concentrating apparatus; 181133 Process of condensing and desiccating buttermilk; 181134 Condensed buttermilk.

Switzerland: 77531 Churn mechanism; 77532 Milk skimming device.

United States: 1255186 Milking machine cluster; 1255239 - 1256793 Milking machines.

VARIOUS. — *Switzerland*: 77478 Hydro-electrical installation for operating agricultural machinery.

United Kingdom: 112987 Humidifier.

United States: 1255055 Hydraulic pump.

RURAL ECONOMICS.

683 — **Organization of Ten Dairy Farms in the Bluegrass Region of Kentucky.** — ARNOLD, J. H., in *U. S. Department of Agriculture Bulletin* No. 548, (Office of Farm Management), pp. 1-12. Washington, D. C., May 24, 1917.

This bulletin presents a brief analysis of the organization of 10 dairy farms selected and studied during 1914 in Mason, Scott and Madison Counties, in the bluegrass region of Kentucky.

The adaptation of the soil to bluegrass pasture is the distinctive natural advantage which these localities have for this type of farming. The

climatic factors, however, partly offset this advantage, especially for the production of cheese and butter. The long summer months are warm, with a lower rainfall than the winter months, while in the extensive dairy sections of Wisconsin and New York the highest rainfall is during the summer months which average 7 to 8 degrees F. cooler than in Kentucky. These adverse conditions have not interfered with the increased production of market milk where there is a demand at good prices, but they are a handicap, especially in the production of cheese, which is produced to best advantage in a climate that is relatively cool.

Receipts from Dairy Products, together with Labour Incomes of Each of Ten Farms. — The business of each of the 10 farms studied may be summarized briefly as follows:—

TABLE I. — *Size of farms, with number of cows and with receipts from labour income and dairy products.*

Farm No.	Size of farm acres	Number of cows	Labour Income	Gross receipts from milk	Receipts from cream	Receipts from butter	Gross receipts per cow	Receipts from dairy	Receipts from tobacco
1 . . .	400	75	\$ 1 466	\$ 5 315	\$ 2101	—	\$ 98.88	80	10
2 . . .	290	30	3 654	4 500	—	—	150.00	67	13
3 . . .	247	19	1 739	3 066	730	—	199.78	82	2
4 . . .	150	50	6 498	6 768	1128	\$ 25	158.00	72	9
5 . . .	51	15	3 201	2 920	225	260	227.00	85	9
6 . . .	86	9	1 121	76	1996	—	230.00	80	4
7 . . .	82	30	1 509	2 966	480	—	114.86	90	0
8 . . .	70	4	— 130	—	208	—	52.00	55	0
9 . . .	134	12	287	—	624	—	52.00	49	15
10 . . .	120	12	— 521	—	104	780	73.60	51	0
Total Average	163	27	1 773	2 501	689	106	126.16	71	5.8

The market price of milk distributed to customers ranged from 7 to 10 cents per quart, and cream 60 cents to \$ 1 per gallon. When the milk was retailed in larger cities through local distributors the farmer received 15 to 20 cents per gallon and paid 1 ½ to 2 cents per gallon to ship it 30 to 50 miles.

The labour incomes on most of the farms were large as compared with those of successful farms of other types in this region. The average labour income on 187 farms was \$ 750, while the average of these ten dairy farms was \$ 1 773. On the ten farms studied those which sold market milk and which had high receipts per cow made the largest labour income.

Seven Successful Dairy Farms Analyzed and Compared. Table II shows the capital invested and the receipts and expenses on seven successful dairy farms.

TABLE II. — *Seven Successful Dairy Farms Analysed and Compared.*

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7
\$ ⁷⁰ of farm (acres)	499	299	247	159	51	86	82
Number of cows	75	39	19	59	15	9	39
Number of other animal units (1)	37	28	16	48	11	33	39
Total capital (2)	\$ 59 097	26 896	15 396	33 081	8 813	16 800	13 661
Working capital (3)	7 874	6 881	3 046	11 354	2 786	2 675	3 396
Tenant's capital	—	—	—	—	—	—	1 698
Total receipts	11 824	8 383	5 105	12 500	5 449	2 982	5 134
Receipts from dairy	7 416	4 500	3 796	7 921	3 495	2 072	3 416
Expenses (4)	7 854	3 385	4 438	2 818	1 811	1 021	2 632
Farm income (5)	3 970	4 998	2 569	8 062	3 638	1 961	3 102
Tenant's farm income	—	—	—	—	—	—	1 594
Labour income (6)	1 466	3 654	1 739	6 468	3 196	1 121	1 599
Owner's profit on investment	—	—	—	—	—	—	12.6%

(1) Animal unit — the equivalent of 1 cow, horse, or beef animal; 2 heifers, 4 calves, 7 sheep, 5 hogs, 14 pigs, or 100 chickens are counted as equivalent to an animal unit.

(2) Total capital includes investment in land, buildings, machinery, live stock, feed supplies, and cash to run the business.

(3) Working capital includes all items of capital except land, buildings, and other improvements usually included in real estate.

(4) Expenses include a charge for unpaid family labour, depreciation, and 5 per cent interest on total capital besides money actually paid out in conducting the farm business.

(5) Farm income is the total receipts less expenses.

(6) Labour income is farm income less 5 per cent interest on invested capital.

Farm 1 is the largest of the ten in question and is valued at \$ 125 per acre. It is well situated near a market point. While it is somewhat rolling the soil is of good quality and nearly all of it tillable. If properly organized, this farm should have made the largest labour income of the group; instead it is among the lowest of those which were only fairly successful. In the first place receipts per cow are low as compared with those of the more successful farms. Half this acreage could easily be made to support this herd. With a higher degree of diversity and by handling other live stock, the gross income of this farm should be increased considerably without much more expense. The average expenses of the ten farms are about 45 per cent. of the receipts, while on this farm they are about 75 %, showing that the business was too expensive for the income received. This farmer housed his cows in a \$ 7 000 dairy barn, an investment of nearly \$ 100 per cow, while his nearest competitor, one of the most successful farmers of the group, had but one third of this amount invested. This farm, although large, failed to produce as much feed for dairy stock as the average farm (\$ 18) and expended for purchased feeds \$ 20 per cow.

Farm 2 is one of the most efficiently organized larger sized farms. The diversity is much larger than that of farm No. 1. About 46 per cent of the receipts were from sources other than dairying, mainly wheat and tobacco. Sales of live stock amounted to \$ 1 290 above purchases.

The operator owned 132 acres and rented 158 additional ones for which he paid \$ 800 a year. All the feed except concentrates was raised on the farm. Only one man was hired, the operator and his family doing most of the dairy work; 33 acres of maize for grain, 12 acres of silage maize, 50 acres of wheat, 25 acres of meadow hay and 5 acres of tobacco were raised, by his own and hired labour; 11 acres of tobacco and 10 acres of maize were raised by a cropper.

Farm 3 had 10 acres of maize for grain, 8 acres for silage, 10 acres in rye which was grazed, and 20 acres in hay. There were 153 acres in pasture, 2 acres in garden and orchard, and the remainder, 44 acres, was considered waste land. The topography was hilly and not well adapted to cultivated crops. The land was valued at \$ 40 per acre, though the more level land in the community was valued at \$ 100 to \$ 150 per acre. Three year-hands were employed on this farm and seven head of work stock were kept. Both man-labour and horse-labour were poorly utilized. A better utilization could have been achieved and the income considerably increased if a few acres of tobacco had been raised. There were no receipts from crops and diversity was low.

Farm 4 may be classed as the best dairy farm of the ten. While the receipts per cow were considerably above the average, others had higher receipts per cow, but in the expenses this farm showed high efficiency in the economy of the labour and feed, two most important factors. Operating expenses were only about 35 per cent of receipts as compared with 45 per cent, the average for the ten farms. The land area (150 acres) was small as compared with the number of stock units kept on the farm. These numbered 98, or about 1.9 acres for each animal unit. Of this number of animal units 50 were dairy cows. The food purchased amounted to about \$ 10 per cow. About 50 per cent of the farm area is in bluegrass pasture. About \$ 1 000 of the total receipts represented breeding fees. During the last two years (1915-1916) hemp has been substituted for tobacco, and yields 1 700 lbs per acre which, at 10 cents per pound, represents \$ 170 per acre. The expense of growing an acre of hemp is about the same as that of tobacco (\$ 50 to \$ 60 exclusive of rent), and the average rent for the land is figured at \$ 30 to \$ 50 per acre. This farm, operated by a graduate of an agricultural college, is rated among the best dairy farms in the State. The work of milking, bottling and distributing is done by the operator with the help of a man and a boy.

Farm 5 shows the possibility of profitable dairying on a small farm with a small amount of capital invested on which almost all the labour is done by the operator and his family. Operating expenses were but 33 % of receipts and the labour income was among the highest of the group. The receipts per cow were unusually high and allowed an expense of \$ 25 per cow for purchased feed. This farm produced \$ 500 of tobacco on 3 ½ acres, \$ 80 of poultry and \$ 115 of increase in value on colts raised. The farmer owns 40 acres and rents 11 acres in addition for hay; 25 acres are devoted to permanent bluegrass pasture.

Farm 6 was only moderately successful. Profits could have been in-

increased greatly if the business had been made larger by increasing the income from cows. If the operator had hired a man he could have increased his herd to 20 or 25 cows and besides could have raised 5 to 6 acres of tobacco instead of 2. There were no receipts from hogs and only \$75 worth of skim milk was sold.

Farm 7 was operated by a tenant who had a half interest in the working capital of the farm. Business expenses were shared equally, as were also receipts. The tenant with the help of two year-hands and some extra labour, performed the work; 45 acres of the farm were in maize for silage, 33 acres in pasture, 2 acres waste and 1 acre for garden. Receipts from sources other than dairy cows were mainly from young stock. There were no receipts from crops.

The Farms that Failed.—The three unprofitable farms of the ten were inefficiently organized and operated. Apparently these farmers depended mainly on dairy products for an income, but each was operating a small-sized business on a fair-sized farm. It does not pay a farmer to give special attention to the dairy business unless there is a sufficient number of cows to warrant special equipment, the application of most of his time, and the development and maintenance of a profitable market.

Comparison of the Seven More Successful Dairy Farms with the Average of Ten.—Table III compares the average of the seven successful dairy farms with the average of the whole group, with respect to the more essential factors.

Comparison of the Seven More Successful Dairy Farms with the Average of Ten.

	Average of 10 farms	Average of 7 successful farms
<i>Distribution of crops:</i>		
Average size of farms.	acres 163	187
In crops.	" 66	79
In pasture.	" 76	109
In maize for grain.	" 15	19
In maize for silage.	" 13	16
In meadow.	" 13	15
In wheat.	" 16	20
In tobacco.	" 5	6
In miscellaneous.	" 4	3
<i>Distribution of live stock:</i>		
Dairy cows.	number 27	40
Young stock.	" 21	16
Swine.	" 29	25
Poultry.	" 181	183
<i>Distribution of capital:</i>		
Total capital invested.	\$ 22 552	\$ 23 662
Total working capital.	4 764	5 286
Machinery.	711	771
Investment in live stock.	3 291	3 699
Cash to run farm.	495	420
Feed and supplies.	355	366

	Average of 10 farms	Average of 7 successful farms
<i>Distribution of receipts:</i>		
Live stock products,	\$ 3 554	\$ 4 610
Live stock inventory and sales,	1 048	1 035
Crop receipts,	589	813
Miscellaneous,	120	235
	<hr/> 5 301 <hr/>	<hr/> 6 693 <hr/>
<i>Profits:</i>		
Receipts per cow,	\$ 126	\$ 164
Average farm income,	3 149	4 266
Average labour income,	1 773	2 954
	<hr/>	<hr/>
Per cent. net earnings on investment,	10	14

These comparisons illustrate many of the points discussed for the different farms. For instance, the average successful farm had the largest business, as shown by the size of farm, the number of dairy cows, and the working capital. On the average successful farm there were more receipts from crops and miscellaneous sources than were shown for the average of the ten farms. The most important comparison is that shown for the receipts per cow: \$ 164 on the average of the successful farms and \$ 126 on the average of the whole group.

AGRICULTURAL INDUSTRIES.

684 — **Wine Making With Foxy Grapes** (1) — CADORET, ARTHUR, in *Le Progrès rural et viticole*, Year XXXV, No. 12, pp. 274-275. Montpellier, March 24, 1918.

A method is described (derived from the work of the late Prof. BOUFFARD and of PIERRE ANDIEUX and used for about 15 years by an agricultural syndicate) by which the foxy flavour of Clinton wine may be removed. The process consists of:—

- 1) harvesting shortly before complete maturity;
- 2) fermentation for 24 hours;
- 3) treatment with 9 gm. of sulphite for red wines;
- 4) strengthening for 2 or 3 days.

The method is still more satisfactory if the selected or natural yeasts of the country are utilised in combination with the sulphurous acid.

Quite recently the author obtained good results with Noah grapes which had not been treated in the vat by the following method:—

- 1) treatment with 1 % of oil;
- 2) repeated stirring for 48 hours;
- 3) decanting;
- 4) filtration through wood charcoal;
- 5) clarifying with 1 % unskimmed milk.

He intends to adopt the first method with his Noah grapes at the next harvest, and believes he will thus free them from all foxy flavour.

(1) Cf. *R. May*, 1916, No. 555 and Feb., 1917, No. 183. (*Ed.*)

- 685 - **Cupreous White Wines with Extreme Delayed Thickening.** — CARLES, P., in the *Annales des Falsifications et des Fraudes*, Year XI, No. 111-112, pp. 43-48. Paris, January-February, 1918.

For about twelve years there have been brought from time to time to oenological chemists, white wines of strange appearance, bad keeping qualities and, sometimes, doubtful hygienic value. These wines show nothing abnormal during the time they are treated as usual in the casks, but turn leaden when bottled, then become gradually thicker till they are eventually unsaleable. The rate of the thickening ("lonche") varies according to the season and the composition of the wine, and is more rapid in proportion as the weather is hotter and there is less air between the liquid and the cork. Thickening stops suddenly when the wine come into contact with the air by being poured into a cooler, or if a few drops of hydrogen peroxide are added, and may be stopped from one day to another simply by removing the cork and leaving the bottle standing up. If the wine is poured back into a corked bottle the thickness reappears, though, beyond a certain limit, this re-starting is no longer possible. These phenomena are obviously due to a chemical reducing agent and an oxidising agent both acting on an unknown factor the proportions of which are minimum, as is very evident.

Wines behaving in this manner have the ordinary composition of white wines, but contain a few grams of fruit sugar, and are relatively rich in sulphurous acid; they are white wines sweetened by a sweeter one or with sugar and treated with sulphurous acid (anti-ferment). It is the small amount of sugar which is the principal reducing agent.

The unknown factor is copper, and the precipitate is red oxide of copper, caused by reduction by the grape sugar and sulphurous acid. There is no doubt that at least part of this copper comes from anti-cryptogamic sprays the bases of which are copper salts. Wines subjected to mutage contain very little tannin and their degree of acidity, sugar content and newness, in general, do not help to free them from metals. They thus take up the copper with which the grapes have been treated and keep it to an excessive extent.

There are many ways of testing whether white wines will thicken late. The method given is based on the capacity of tannin to make the copper dissolved in the wine insoluble and the capacity casein then has to remove the copper tannate in the lees.

Into 1 litre of wine is poured 1 cc. of $\frac{1}{10}$ clear solution of tannin, or 0.10 gm. The whole is mixed and, after a few minutes, 10 cc. of skim milk are added (or, per hectolitre, 10 gm. of pure tannin and 1 litre of skim milk at the most). The mixture is well shaken, left for at least 24 hrs., then filtered. If copper is present it is contained in the deposit. The liquid is filtered, air-dried, and burnt. It is easy to dissolve everything in the ash with hydrochloric acid and to separate the copper by simply filtering with an excess of ammonia. The estimations may be made electrolytically or colorimetrically, since the original quantity was 1 litre.

In order to make sure that the treated wine no longer contains copper the clarified litre is evaporated in a porcelain dish, a little acid magnesium

nitrate added, and the residue burnt; this may be done easily and completely with successive additions of fresh dilute nitric acid. It is essential to burn even the very smallest particles of carbon. The process is then continued as described above with hydrochloric acid, ammonia in excess, etc., or by any other method for separating copper from an inorganic mixture.

From an hygienic point of view, the amount of crystallised copper sulphate contained in such wines — according to the author, 0.015 gm. per litre — if taken at meals by healthy adults is not injurious to the health, but may be so if drunk between meal times. Invalids, old people and those suffering from liver complaints should not use these wines as a daily drink, the more so as similar quantities of copper may be contained in certain chocolates and even in native dwarf beans. In such cases, however, the consumption in weight of food is less than in the case of wine, and the food is not taken daily, with all meals, and between meals, as is wine. Finally there is no doubt that, by passing through the roots of the cacao tree and bean plant, the copper has been made innocuous, but this is not so with wines because the greater part of the copper has been deposited on the grape in the form of copper mixture and is found in this state in the must.

686 — **The Mycodermis of Wine.** — DE ROSSI, G., in *Le Stazioni sperimentali agrarie italiane*, Vol. IV, Pt. II, 11-12, pp. 529-562, Bibliography of 20 publications, 2 Pl. with 15 Fig. Modena, 1917.

The author has found at least 4 different species of mycodermis capable of acidifying wine, each with clearly different physiological aptitudes. These species are: — *Mycoderma vini*, which causes a very weak consumption of both the alcohol and the total acidity of the wine, while it does not produce volatile acids in sufficient quantity to influence the organoleptic properties; *M. acidificans* which produces a large amount of volatile acids and thus even seriously changes the wine; it ceases growth at 32-33° C.; *M. duplex* and *M. tenax*, much more suited than the others to live in an acid medium, attack the acids very actively at a temperature above 15° C., but not destroying the alcohol vigorously; *M. duplex* grows well in the presence of 9-10 % alcohol; *M. tenax*, on the contrary, cannot support more than 4 to 5 % of alcohol.

687 — **Cement Vats.** — MATRIEU, L., in the *Revue de Viticulture*, Year XXV, Vol. XLVIII, No. 1241, pp. 230-233. Paris, April 11, 1918.

Owing to the war there is a shortage of casks, and it has been necessary to use all sorts of second-hand barrels, which sometimes give the wine a foreign taste; in some cases cement vats are used and the question has arisen as to whether such vats are as serviceable as those of wood. The vat may be used for two distinct purposes — for fermentation, in which case the wine only remains in it during the process, or for storing the wine.

The material of which the sides are made, if well fired, can have no influence even on the finest wines, during the few days fermentation lasts.

For keeping wine, however, the wood is of great importance, so much so that for certain choice wines new oak of good quality is absolutely necessary for the long fermentation of white wines and for keeping the wine

fter the first tunning. New oak imparts to the wine a taste due to its soluble substances, so that the use of choice oak has become necessary, as it is also for refining the alcohols of wine.

Oak chips, which would give up their useful substances, can be added to wine in a cement vat. Small wooden casks are, however, favourable to slow oxidation by reason of their porosity, thinness, and the large surface in contact with the air. From this point of view cement vats would be more suitable for wines the aging of which should be retarded, as oxidation is the essential factor of this process. The impermeability of the sides of cement vats to oxygen may be counteracted by periodical injections of air into the wine, which may then be left to oxidise.

Great care must be taken with choice wines, and no modification in the method of making or keeping them should be introduced till repeated tests have shown that the taste will not be modified thereby.

Cement vats should have no cracks, and the sides, joints, iron-work of the cover, and pipe connections (if red copper or bronze are replaced by brass) must not be subject to attack by acids. The absence of cracks results from the composition of the material used, which must be resistant to all surface contraction. Resistance to the acids of the wine may be obtained by direct treatment of the cement with tartaric, sulphuric solutions or silicate, by lining with glass, etc.; the joints also should be treated.

Another danger of cement vats for keeping wine in summer is the formation by drops in temperature of a free surface which may give rise to an excess of air and acetification; as acetic acid is denser than wine it diffuses rapidly. This may be prevented by a slanting bottom, but preventative measures are often useful.

638 — **A Method for the Separation of Protein from Non-Protein Nitrogen in Wheat Flour.** — BLISSE, M. J. (Montana Agricultural Experiment Station, Bozeman), in *The Journal of Biological Chemistry*, Vol. XXXIII, No. 3, pp. 551-556 + 3 Tables. Baltimore, 1917.

Previous to investigating the biochemical changes in frosted wheat, and their relation to bread-making value, and in order to study the effect of premature freezing on the nitrogen compounds of the wheat kernel, the author found it desirable to develop a satisfactory method for the separation of protein from non-protein nitrogen in wheat flour.

None of the separation methods used for biological products seem to be satisfactory for use with cereals, since these contain alcohol-soluble proteins that do not occur in any other plant or animal tissues. Reagents ordinarily used for precipitating proteins, such as alcohol, acetic acid, trichloroacetic acid, colloidal iron, phosphotungstic acid, tannic acid, etc., are unsatisfactory for removing gliadin from water extracts of flour. The method of RITTHAUSEN (1872), which consisted in alternately adding to the protein in solution dilute copper sulphate and potassium hydroxide until the copper precipitate would no longer dissolve, was found to be the best available by OSBORNE and LEAVENWORTH in their researches on copper-protein compounds; the value of the method can be seen by comparing the

amounts of total nitrogen not precipitated found by using 50 cc. portions of extract :— colloidal iron method (at room temperature), 0.00266 gm.; same method, at boiling temperature, 0.003 gm.; phosphotungstic acid method, 0.0010 gm.; tannic acid method, 0.0012 gm.; copper sulphate method, 0.0008 gm.

The following details of the copper method as used on flour extracts are given below :— 1) *proportion of flour to water in the extract* : the best is 20 parts of distilled water saturated with toluene to 1 part of flour ; 2) *duration of the extraction* : the quantity of nitrogen found in different extracts was the same for extractions lasting 2, 3, 4, 5, 6, and 12 hours respectively ; a minimum extraction period of 2 hours (during which the extract is shaken vigorously every 15 minutes) was adopted ; 3) after filtering the extract, the proteins are precipitated by treating 50 cc. of the filtrate with 15 cc. of N/10 NaOH, followed by 16 cc. of N/10 CuSO_4 . The amount of Cu SO_4 used should be slightly greater than the equivalent quantity of NaOH. The nitrogen content can be afterwards determined in the filtrate separated from the cupric precipitate by the usual Kjeldahl method and the amino-acids by Van Slyke's microchemical method.

The effectiveness of the test was examined by ascertaining the chemical nature of the nitrogen compounds that remained in solution after the copper proteins precipitation, and it was concluded that the *true proteins were almost completely precipitated* ; only (and other authors confirm this), traces of peptide linkings still remain in solution.

Normal patent flour contains but about 2 mgm. of amino-acid nitrogen for every 100 gm. of flour, and about 3 times as much nitrogen in free acid amide form.

There is probably a considerable amount of *non-protein nitrogen* not precipitated by the copper method which is neither amino-acid nitrogen nor is it the form of peptide complexes ; its nature is not known.

659 — **The Milling Value of the Wheats "Aurore" and "Blé des Alliés."** — See No. 657 of this Review.

670 — **Milling and Breed-Making Tests with Humpback Wheat, in the U. S. A.** — See No. 847 of this Review.

691 — **A Comparison of Linseed Oil and Lumbang Oil as Paint Vehicles.** — AGUILAR, R. H., in *The Philippine Journal of Science*, Vol. XII, Sec. A, No. 5, pp. 235-243 (Fig. Manila, September 1917).

"Lumbang bato" (*Aleurites moluccana*) is of very wide geographic distribution extending from India through Malaya to Polynesia. In the Philippines it is common and widely distributed both as a native and as a semicultivated tree. "Lumbang banucalag" (*A. trisperma*) is confined to the Philippine Islands and less common than the preceding species. The seed of *A. moluccana* yields from 60 to 65 per cent oil by extraction with solvents and 55 per cent by hydraulic expression at 500 kg. per square centimetre ; the seed of *A. trisperma* yields about 43 per cent by hydraulic ex-

pression at 310 kg. per square centimetre. (The per cents are calculated on the kernel weight).

The lumbang oils are possible substitutes for linseed oil, and they have been much studied, but little has been reported concerning their behaviour with different pigments or the quality of the resulting paints. For this reason the author carried out a series of tests on the properties of linseed, lumbang bato and lumbang banucalag oils described in the article under consideration, experiments which gave the following results:—

The drying properties of lumbang bato and lumbang banucalag oil are comparable with those of linseed oil.

Lumbang bato oil is very similar to linseed oil in its properties as a paint vehicle, and like linseed has certain disadvantages for use in red paints.

Lumbang banucalag oil cannot be used as a paint vehicle, especially with red lead; it dries into a paste. This is also true with lumbang bato containing 75 and 90 per cent lumbang banucalag. Lumbang banucalag containing between 50 and 75 per cent lumbang bato will make a good vehicle for red lead.

- 692 - **The Use of *Bacillus felsineus* in Retting Various Textile Plants** (1). — CARBONE, D., in the *Bollettino di Studi ed Informazioni del R. Giardino coloniale di Palermo*, Vol. IV, Pt. 1-2, pp. 3-9, Palermo, 1917.

The author has found that *Bacillus felsineus* rets the following textile plants:— nettle; ramie (*Boehmeria nivea*); Spanish broom (*Spartium junceum*); *Agave americana*, *A. Zapote*, *A. sisalana*, *A. Candellabrum*, *A. yuccaefolia*, *A. Rumphii*; *Furcraea gigantea*, *F. altissima*; *Sansevieria cylindrica*, *S. zeylanica*; *Yucca gloriosa*; *Sphacralcea angustifolia*, *Grevia oppositifolia*, *G. orientalis*, *Sida Avicennae*; mallow; bark of mulberry branches; Jerusalem artichoke tubers.

- 73 - **The Proteins of Cow's Milk**. — OSBORNE, T. B. and WAKEMAN, A. J., with the Collaboration of LEAVENWORTH, C. S. and NOLAN, O. L. (Connecticut Agricultural Experiment Station, New Haven), in *The Journal of Biological Chemistry*, Vol. XXXIII, No. 1, pp. 7-17, No. 2, pp. 243-251. Baltimore, January and February, 1918.

In all attempts to discover the nature of the water-soluble vitamins in milk it is essential to know the properties and proportion of protein that remains in solution after removing the casein and heat coagulable proteins. This question was very thoroughly studied by the authors. They separated: 1) *lactalbumin*, the composition of which, when ash- and moisture-free, after drying at 110°C., was:— C, 52.51; H, 7.10; N, 15.43; S, 1.92; P, traces; D, 23.04; it was present at the rate of about 2.4 gm. per litre of the original whole milk; 2) *lactoglobulin*, present at the rate of about 0.2 gm. per litre of original whole milk and with the following composition:— C, 51.88; H, 6.96; N, 15.44; S, 0.86; P, 0.24; O, 24.62; 3) an alcohol soluble protein,

¹ (1) See *ibid.*, October 1917, No. 956. (Ed.)

obtained from the alcoholic washings of the casein precipitate and present in very small amount.

Long and repeated attempts to find if there are any *proteoses* present in the milk, gave no definite results.

SIEGFRIED obtained a product from cows' milk which he called "mucleon", and the authors have concluded that this substance is probably a mixture of uncoagulable protein and some still unidentified organic substance which yields phosphoric acid on hydrolysis.

In the second work, the authors describe their researches on the alcohol-soluble protein, which has the composition:—C, 54.91; H, 7.17; N, 15.71; S, 0.95; P, 0.08; O, 21.18. On analysis 100 gm. of the protein gives:—arginine, 2.92; histidine, 2.28; lysine, 3.98; tyrosine, 2.47. It is an acid compound and gives strong tryptophane, Millon's and buret reactions.

694 — On the Thermo-Resistance of Non-Sporogenous Bacteria in Milk. — CORINI C. in *Reale Istituto Lombardo di Scienze e Lettere, Rendiconti*, Vol. XLVIII, Pt. 18 pp. 959-961, Milan, 1915.

A contribution to the study of the thermo-resistance of sporogenous bacteria, which emphasises the principle:—that species or races endowed with exceptional thermo-resistance should be accepted with great caution and it must be ascertained whether such a property is really a character that is *permanent and common* to the generality or at least to the majority of the individuals of a given race of bacteria or whether, on the contrary, it is a case of a protective influence similar to that found by the author in milk. In fact, the author's researches on the survival of non-sporogenous bacteria in sterilised milk, show that it is due, not to the existence of species or races having exceptional thermo-resistance, but rather to the protecting influence of caseous envelopes that form round the organism, apparently due to the life-activity of the germs themselves before and after sterilisation.

695 — New Contribution to the Commercial Sterilisation of Milk. — CORINI C., in *Rendiconti del Reale Istituto Lombardo di Scienze e Lettere, Series II*, Vol. LI, Pt. 1-2, pp. 175-180, Milan, 1918.

The sterilisation of milk has already passed through two successive phases of technical progress. The first succeeded in preserving the milk from *rapid and violent changes*, the second from *retarded and slow changes*. By his present studies the author proves that if it be possible to say that this latter problem has been satisfactorily solved by means of improvement in technical methods, there remains yet a third, and perhaps final, obstacle to be overcome. This is the *insidious change* of sterilised milk which can be recognised only after the vessel has been opened and by heating. This change differs from the others in that it is often very difficult to ascertain the bacterial cause, so that mistakes may be made by attributing it to a purely chemical cause.

It is caused by the "acid-rennet producing" bacteria proved by the author to be present in the cow's udder, especially under conditions of it

inflammation, even when physiological, because the bacteria survive sterilisation owing to protective coverings which form in the udder or during heating. Moreover the milk may leave the udder containing already enough of this "rennet" enzyme to undergo the insidious change in question by the sole effect of heating even if the organisms are largely dead or inactive. Finally this change differs from the others in that preventative measures cannot be adopted against it in the dairy; they must be applied directly in *the shippon and on the dairy cows*. Methods must be used which will inhibit the abnormal development of the bacterial flora of the udder (careful and complete milking, discarding of the first streams of milk, exclusion of all milk left stagnant in the udder or from inflamed udders even under slight, temporary physiological conditions, etc.) and *dairy cows should be selected according to the bacterial flora of the udder*, as proposed by the author in a previous paper (1). If these principles, as has been the case with the previous ones, are adopted practically in the industry, the remaining difficulties attending the sterilisation and preservation of either sterilised or condensed milk may be eliminated.

695 — **The Composition and Market Qualities of Butter when Corn Silage is Fed with Cottonseed Meal.** — PALMER, L. S. and CROCKETT, D. T., in the *Journal of Dairy Science*, Vol. 1, No. 3, pp. 235-245. Baltimore, September, 1917.

One of the most important facts brought out in a recent bulletin (2) regarding the effects which the feeding of cottonseed products exerts upon the composition and properties of butter, was the tendency for certain roughages to counteract in large measure the usual results which follow the use of cottonseed meal. Attention was directed particularly to the counteracting influence of corn silage, but a somewhat limited amount of data were presented by ECKLES and PALMER with regard to the extent to which corn silage counteracts the peculiar market qualities of cottonseed meal butter, just described. As this phase of the question is of considerable practical importance, a more extended study of this point was made by the writers and the results of their experiments are here presented. Twelve pure-bred cows were selected from the University herd and divided into two groups of six cows each.

The general plan of the experiment, together with the average ration consumed by each group in each period, and the duration of each period is shown in Table I.

(1) GORINI, C., *Rend. R. Ist. Lomb. Sc. Lett.*, 40, 1916.

(2) ECKLES, C. H. and PALMER, L. S.: *Effects of Feeding Cottonseed Products on the Composition and Properties of Butter*. Missouri Agr. Exp. Station Research Bulletin 27, pp. 44, Figures 3, 1916. See R., July, 1917, No. 651. (Ed.)

TABLE I. — *Plan of experiment and average ration consumed in each period.*

Period	Date	Group I.	lb.	Group II.	lb.
1	Nov. 5 to Nov. 22, 1916	Silage	29	Silage	28
		Hay (1)	9	Hay	9
		Grain (2)	8	Grain	9
2	Nov. 23 to Dec. 15	Silage	29	Silage	18
		Hay	9	Hay	7
		Grain	6	Cottonseed meal	3
		Cottonseed meal	3		
3	Dec. 15, 1916 to Jan. 7, 1917	Silage	29	Hay	18
		Hay	9	Grain	4
		Grain	4	Cottonseed meal	5
		Cottonseed meal	5		
4	Jan. 1 to Jan. 21	Silage	29	Silage	28
		Hay	9	Hay	10
		Grain	7	Grain	9

(1) The hay fed to both groups throughout the entire experiment was a mixture of equal parts alfalfa and timothy.

(2) The grain fed to both groups throughout the entire experiment was a mixture of maize meal two parts, distillers grains one part, wheat bran one part.

Results of experiment.

Composition of butter. — An examination of the figures given for the analyses of the different churnings of butter for moisture, fat, curd, ash and salt shows no differences in the composition of the different samples of butter which can be attributed to the changes in the ration.

Score of butter. — On examining the data concerning the market quality of the various samples of butter, as shown by the usual method of scoring, it is seen that all the samples of butter were of good quality, the only defect from a commercial point of view being in flavour. Certain slight defects in body were noted in some cases but these were not sufficiently pronounced to lead to a deduction in the score. For example, the butter from three of the churnings of period 2 was characterized as hard and brittle; similarly the body of both churnings of group I in period 3 was stated to be hard, although not objectionably so, while no note was made with regard to the body of either churning from group II in this period. With regard to the oily flavour which frequently characterizes cottonseed meal butter, this was noticed only in the case of the two churnings from group I in period 3.

The results of these experiments on the market qualities of the butter may be, therefore, summarized as follows:

1) Cottonseed meal, when fed in quantities of 3 to 5 pounds imparted a slight oily flavour and harder body to the butter, but these defects were not sufficiently pronounced to detract materially from the market value of the butter.

2) The effects of the cottonseed meal feeding were fully as pronounced when fed with maize silage, as when a mixture of alfalfa and timothy hay constituted the only roughage.

Keeping quality of butter. — Previous experiments have been uniform in showing that butter made when cottonseed meal forms a part of the ration retains its original flavour appreciably longer than when no cottonseed meal is fed. The general result of the study was to confirm the former results showing a superior keeping quality of butter made on a cottonseed meal ration over that made when the ration contains no cottonseed meal. The feeding of cottonseed meal materially retarded the rate of deterioration of butter kept at 8° to 12° C. This effect was secured when the cottonseed meal was fed with maize silage as well as when it was fed with hay.

Chemical and physical constants of butter fat. — The results of the analyses of the butter fat are shown in Table II.

TABLE II. *Chemical and physical constants of butter fat on different rations.*

Period	Group	Saponification Value	Reichert-Meissl Number	Iodine-Value Hubl	Melting Point °C	Standing-up Temperature °C
1	I	234.9	31.66	28.16	32.90	34
2	I	232.9	30.95	29.01	34.15	34-35
3	I	233.4	31.03	28.88	34.10	35-36
4	I	232.2	29.63	30.22	33.93	34
1	II	236.8	33.27	29.79	32.35	33
2	II	229.2	29.63	34.69	34.35	35-35
3	II	227.4	30.01	34.42	33.98	35-36
4	II	232.5	30.73	32.11	32.45	33

Abnormally high saponification and Reichert-Meissl values and an abnormally low iodine value are the striking features of the fat constants during liberal silage feeding. The melting point of the fat was increased slightly by the cottonseed meal in periods 2 and 3, and this effect was also noticed in the increased standing-up temperature of the butter.

Very different results characterized the feeding of the cottonseed meal in periods 2 and 3 in the case of group II, in which the roughage was also changed to one of hay only. A marked depression of the saponification and Reichert-Meissl value and increase in the iodine value and melting point characterized the fat constants in these periods in comparison with the constants of the fat in the basal periods. The standing-up temperature of the butter was also increased. Such effects are characteristic of cottonseed meal feeding when dry roughage is fed.

One or two other features of the data in Table 2 may be mentioned. It is noticed that the fat constants of group II were not abnormal in any of the periods, even in period 3 when 5 pounds of cottonseed meal were fed with a dry roughage of hay only. These results are probably due, in part at least, to the fact that the fat constants were already abnormal in the opposite direction from those which usually characterize cottonseed meal feeding, when the ration was changed to include the cottonseed meal. Another feature of the data was that no greater effects were secured when 5 pounds of meal were fed to group II than when 3 pounds were fed.

Very great difficulty is also experienced in attempting to explain why the addition of cottonseed meal to a ration containing of a liberal portion

of silage fails to affect any of the fat constants except the melting point of the butter fat. The results of the present experiment on the chemical and physical constants of butter fat may be summarized as follows:—

The liberal use of maize silage in a ration counteracted all the effect which 5 pounds of cottonseed meal usually exert upon the chemical constants of butter fat in that the addition of the cottonseed meal to a ration containing a liberal amount of maize silage was without effect upon the fat constants.

697 — The Determination of Fat in Certain Milk Products. — FRANCIS, C. K. AND MORGAN D. G., in the *Oklahoma Agricultural and Mechanical College, Agricultural Experiment Station Bulletin No. 114*, pp. 1-4. Stillwater, Oklahoma, April, 1917.

A method for determining fat, including treatment of the samples, in such dairy products as ice cream (requiring 14 % fat content by law), evaporated milk, malted milk, dried skim-milk and similar milk products, is described. The procedure is similar to that followed when using the Babcock test, but in place of sulphuric acid, mixtures of glacial acetic, sulphuric and nitric acids are prescribed. The fat is separated and read in a Babcock bottle.

698 — Wool Studies. — Washing Sheep Before Shearing; Time of Shearing. — HAMMOND J. W., in the *Ohio Agricultural Experiment Station Bulletin No. 294*, pp. 309-322. Wooster, Ohio, April, 1917.

This experiment was undertaken for the purpose of securing data on the following points:— 1) The influence of washing sheep on the yield of grease and of scoured wool and on the rate of gain made by the sheep; and 2) the influence of the time of shearing on the yields of grease and scoured wool and on the rate of gain made by the sheep.

Plan of the Experiment. — One hundred lambs, practically purebred Merinos, born in 1910, were divided into four lots as nearly alike as possible with respect to sex, weight and conformation. The experiment extended over a little more than 2 years, so that during its progress three clips of wool were removed.

The treatment of the lots with respect to washing and time of shearing was as follows:—

Lot 1: Washed; shorn about April 12.

Lot 2: Unwashed; shorn about April 12.

Lot 3: Washed; shorn about June 1.

Lot 4: Unwashed; shorn about June 1.

Washing and shearing. The sheep were washed by hand in a stream 7 to 10 days before shearing with power-driven clippers.

Scouring the wool. — The scouring was done by the emulsion process, similar to that used commercially. The wool was put through three scouring liquors containing potash, soap and potassium carbonate of gradually diminishing strength, and finally through a rinse of clear warm water. The wool was dried to a constant weight at a temperature of 150° F. both before and after scouring to overcome any differences in moisture content.

From the results presented it appears that the washed sheep produced

40 pounds less grease wool per head when shorn April 12, and 2.64 pounds less per head when shorn June 1, than did unwashed sheep shorn on the same dates. Washing the sheep had practically no effect on the amount of scoured wool produced or on the rate of gain made by the sheep.

Wool shorn June 1, both washed and unwashed shrank more in scouring than did wool shorn April 12.

The results of this experiment also indicate that, in many cases at least, not sufficient premium is paid for washed wool to cover the cost of washing and for the loss in weight of the wool.

Since washing sheep does not improve the quality of the wool fibre and does not diminish the cost of scouring, the practice is not beneficial to the manufacturer.

Washed sheep shorn April 12 produced more grease wool than did unwashed sheep shorn June 1, while unwashed sheep shorn April 12 produced less grease wool than did unwashed sheep shorn June 1. This indicates that between these two dates there was an increase in weight of fleece due to the accumulation of a greater proportion of yolk or other foreign matter in the wool. Sheep shorn April 12, both washed and unwashed produced slightly more scoured wool than did sheep shorn June 1. Sheep shorn April 12 made slightly greater gains than did sheep shorn June 1.

599 - **The Indian Hide and Leather Trade.** — I. EDGARD HENRY (Late President, Upper India Chamber of Commerce), in the *Journal of the Royal Society of Arts*, Vol. LXVI, No. 3407, pp. 274-282, London, March 8, 1918.

The quality of the hides from Indian cattle is not so good as that from Argentine cattle, for, while Argentine cattle do no work, the Indian oxen are used for agricultural purposes. Moreover, on the Argentine, branding is used as a means of identification only, in India it is commonly adopted as a cure for various ailments. Fortunately the cows and female buffaloes are rarely worked, so that their hides are generally in good conditions and are even superior to those of Argentine cows. In England the hide of a slaughtered animal is worth in normal times from $\frac{1}{12}$ to $\frac{1}{10}$ of its total value, in India, it is worth $\frac{1}{3}$ of the value of the animal. For this reason, when there is a large demand for hides, the cattle are often slaughtered for the value of their hides alone. The Indian hide trade is of great importance, amounting fifth in the value of exports, even preceding tea.

It has been shown that as a result of the increased consumption of meat throughout the world since the war, a great shortage of hides and leather is to be anticipated in the future. It is estimated that the world's meat-producing animals have decreased as follows:—cattle, 28 080 000 head; sheep, 54 500 000 head; hogs, 32 425 000 head; or a total of 115 005 000 head. Before the war the world's supply of hides was barely sufficient, and prices were steadily rising. The above figures show, that after the war there will be a serious shortage of this product.

In those parts of India where the climate is dry the hides are simply cleaned and dried in the sun or shade. Before baling they are dipped in a preservative solution and again dried. This is considered the best method. In the

damp climate of Bengal and during the rainy season in other provinces drying is difficult, and the hides are usually salted. This system does not always give satisfactory results. Arsenicated hides are sold by weight salted hides by the piece after selection and classification.

The hides are divided into various classes as follows :

- 1) "Commissariats" ; these are the best quality hides. The name was derived from the C branded on the neck of cattle bought by the Indian Government to be fed well for about three months and then slaughtered to supply the army with meat. Although this practice has long ceased the term remains and indicates the highest grade of hide ;
- 2) "Slaughtered" , a term applied to the hides of animals which have been slaughtered to distinguish them from those which have died naturally ; they are the second grade ;
- 3) "Deads" , the third grade ;
- 4) "Rejections" , the lowest grade.

These terms are still in use on the chief markets of India.

There are several varieties of goatskins in India. The best, known as "Patnas", are from the province of Behar, and are excellent for making glacé kid. Further east, in Dinagepore, Bengal, and Eastern Bengal, the skins are larger and heavier in grain and texture but still suitable for glacé kid. In the United Provinces and Rajputana the skins are also larger and coarser than "Patnas", and only the lighter ones can be used for glacé kid ; the heavier ones are suitable for "Moroccos", but, unfortunately, often have many holes. In the Punjab the goatskins, known as "Amritsars", are large, strong and heavy, well adapted to upholstery. In the south Hyderabad and Deccani skins are of fair quality and are bought by the Madras tanners.

Before the war 3 million cow, ox and calf hides were tanned in India and exported annually. At the present time this figure is doubled. The tanning industry is of great importance in India and its further expansion is to be anticipated.

The tanning process resembles that which was used in England before the introduction of labour-saving devices. Labour is plentiful in India, and the native tanners still adopt the primitive methods. In Madras and Bombay the tanning material used is the bark of *Cassia auriculata*, which grows in the jungle ; it is a shrub which grows to a height of from 6 to 8 ft., the shoots of which are cut every three or four years. It is an excellent tanning material, making the skins soft and pliable. The hides are often only partially tanned, so that the European currier has to complete the process, often improving the material thereby. At Cawnpore in the United Provinces there are some large tanneries equipped with modern machinery. The first of these factories was erected 40 years ago by the Indian Government and, in normal times, supplied the leather required by the different branches of the army. The chief tanning materials used at Cawnpore are *Acacia arabica* and *Terminalia Chebula*. The former, which is found over a wide area, is not ripe for cutting till ten or twelve years old. Up to the present these plants have not been systematically cultivated. In view of the increasing

demand for tanning material the Indian Forest Department should attempt to produce an ample supply of tanning bark, which will be very necessary in the future, but should not be left to private enterprise.

In addition to the commercial centres mentioned there are still in the villages primitive tanneries for supplying local requirements. Chrome tanning, though adopted only to a limited extent, could be greatly developed.

With reference to the export of goatskins, before the war India exported annually 20 million raw skins and 7 500 000 tanned skins. The United Kingdom purchased most of the tanned skins, about half of which were reexported to the continent, and about a third of the remainder to America.

Of the raw skins, 75 % were exported to America, 10 % to England, 7 % to France, 5 % to Holland and Belgium, and an insignificant quantity to Germany. Since the war America takes 88.5 % and English imports have dropped to 8 %.

Previous to the war 2 200 000 raw sheepskins and about 9 000 000 tanned ones were exported. America took 87 % of the raw skins in 1913-1914, and 96.5 % in 1915-1916. Of the tanned sheepskins, the United Kingdom imported 58.9 % in 1913-1914 and 64 % in 1915-1916, the United States 20.9 % in 1913-1914 and 19.8 % in 1915-1916; Japan 15 % in 1913-1914 and 11.8 % in 1915-1916.

About 100 000 tanned buffalo hides were exported to England. Of the 2 000 000 raw hides one half went to Germany, one third to the United States, and the remainder was distributed between the United Kingdom, Holland and Italy. The export of ox and cow hides reached about 11 million pieces, 3 million of which were tanned; the tanned hides went to England and the raw hides to the Continent.

Figures for the shipments of raw ox and cow hides to Europe and America are given in a table covering the period from 1872 to 1915.

700 - **The Cold-Storage Plant of Lyndiane, Senegal.** - MORSSU, in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 12, pp. 394-400. Paris, March 27, 1917.

The author reviews a study by M. J. DERRÉ who is in charge of the sanitary inspection of the plant of Lyndiane in West Africa. The installation of the Lyndiane plant in Senegal has made possible the exploitation of one of the principal natural resources, hitherto unused but sure to prove of increasing importance as a result of the abundant livestock and immense pasturage lands.

To fulfill the requirements of the home country it has been necessary to make use of herds not only from Senegal but also from the whole of French West Africa. The oxen slaughtered at Lyndiane in 1916 came from Senegal, Niger, Mauritania and Guinea; these districts are in order of importance.

The livestock of different breeds from these districts, which form an immense stretch of land, is not all equally suitable for slaughtering. Owing

to its extensive breeding and the position of its plant near the centres of production Senegal holds the first place for quality of meat. The oxen of the Zebu breed ("peuhle" variety) of the Senegalese provinces of Cayar, Baol and Sine Saloum, give a much higher yield than all the other cattle slaughtered, no matter where they come from.

Upper Senegal-Niger is the reservoir of Senegal for cattle; 4 238 oxen from the Soudan, Macina, or the north of the Niger bend were slaughtered at Lyndiane in the year 1916.

Unfortunately the remoteness of the breeding centres necessitates long journeys which cause the animals to lose flesh and thus decrease the yield, for the average weight of the stock from this district is only 596 lb. The average weight of the animals from Mauritania is 583 lb., with a yield of barely 45 %. French Guinea, a remarkable breeding centre, supplies cattle with an average weight of 506 lb. with a 47 % yield.

During 1916 the plant bought 27 350 oxen with an average weight of 537 lb. giving, when killed, a 46 % yield. This meat is exported to France in frozen quarters or as preserved, seasoned beef.

The Lyndiane installation can slaughter 200 oxen in 24 hours; this figure was reached in December and January, but has dropped to 110 on account of irregular delivery. The plant, originally built for freezing meat only, has five freezing rooms of a capacity of 200 metric tons, and five storage rooms, of a capacity of 300 metric tons. From May 1 to December 31, 1916, 13 198 quarters weighing 777 metric tons were delivered, and at the present time the storage rooms are full. The offal (heart, liver, brain, tongue, kidney) are also frozen, packed in 100 lb. cases and sent to France. The suet, intestines and bones are treated in a separate establishment. During the year 1916, 130 154 lb. of commercial suet and 5 665 lb. of edible fat were sold. The hides are treated with special care and, owing to the proximity of salt water, their preservation is assured until they are utilised in France.

It is estimated that the Lyndiane plant could deal with 30 000 cattle annually, and perhaps more. Besides the cattle, of which there are more than 5 million, there are other resources which could be profitably exploited. Experiments in pig-breeding are now being carried out at Siné-Saloum, and are likely to give good results. Already a rapid production of as much as 5 000 head a year seems likely. The variety used is related to the Spanish breed. It is very prolific and breeding will probably increase with yet greater rapidity since the cultivation of manioc has spread throughout the villages. There are very few sheep in Senegal and they are kept by the natives for their own food. Those in Mauritania and Macina are too far away from Lyndiane to be delivered in a sufficiently good condition.

Breeding, if well carried out, cannot fail to increase and improve rapidly, bringing to the colony an unlooked-for income and to the home country a great simplification of the serious economic problem of its meat supply.

701 - **Enzyme Activity at the Temperatures Maintained in Cold-Stores.**—BLANCHET, A., in *Le Froid*, Year V, Vol. V, No. 1, pp. 6-9. Paris, January-March, 1917.

The investigations carried out by the author in 1913-1914 aimed at estimating the activity of certain enzymes at temperatures slightly below 10°C., generally used in the cold-storage establishments for storing products in which the action of such enzymes or others of the same group may occur.

He studied a lipase to ascertain its action at temperatures corresponding to those used in preserving butter and other fats. The enzyme examined was one existing in the cytoplasm of castor-oil seeds, which is the one best known at the present time; it was the object of a remarkable study by M. NICLOUX. The castor oil seeds were crushed in a mortar and then mixed with castor oil. The mixture was then acidified with acetic acid. The oil, seeds, and acetic acid were previously cooled during 24 hours in cold rooms.

The acidity was estimated with normal soda after the alcohol reaction had ceased. The activity of the lipase at laboratory temperature (17°C.) was also tested.

The results show definitely that, even at -5°C., the lipase is sufficiently active to cause a fairly rapid saponification of the fats. There is, therefore, no reason why a certain number of the changes fats undergo while in cold-storage should not be attributed to the action of enzymes of this same group.

The fact that the good keeping of butter is in inverse ratio to the acidity of the cream at the time of churning confirms this hypothesis, for the action of lipases is generally favoured by a certain acidity. This was confirmed by the enzyme studied by the author as well as by the sero-lipase.

702 - **Preserving Fish without Ice.**—Abstract from the *Bulletin mensuel de la Chambre de Commerce française de New York*, in *Le Froid*, Year V, Vol. V, No. 4, pp. 137-139. Paris, October-December, 1917.

In British Colombia and in England a new method has been adopted for keeping fresh fish. As ice is no longer necessary the fish can be sold cheaper because the expense incurred through the ice is done away with. The fish keeps its flavour perfectly, and the method may be applied to either fresh or smoked fish, and even to meat.

The whole procedure lasts only three hours. The fish is first placed in a cooling tank containing water at a low temperature. After half an hour the latent heat of the fish has completely disappeared. The fish is then placed in a tank containing sea water or fresh water to which salt has been added. To prevent the water from freezing it is stirred by a pump which sends it into a pipe in which it passes through a filter filled with willow charcoal which kills all bacteria and then passes out again. The extremely cold temperature of the salt solution closes the pores of the skin of the fish, prevents saturation and acts on the exterior as a disinfectant. At the end of three hours the fish is taken out and has the appearance of fresh fish. There is no danger of its going bad for 10 days and it may be kept for months in a cold room. A plant has been set up in Portugal for preserving fresh fish by this method. According to the English engineers who installed the plant the fish keeps fresh and in excellent condition

for about 15 days, even at a variable temperature. The flavour is that of fresh fish. It does not go soft like fish kept in ice, and may be smoked after having been treated. The method is highly recommended by the inspector of the Dominion fisheries.

M. A. CRIGNY, Director of the Marine Station of Boulogne-sur-Mer France, believes the method to be of the greatest value. It includes two independent parts, the first of which appears the more original, and may be called pre-refrigeration. It is always advisable to wash fish before any freezing procedure, and it would be excellent to wash it in very cold water which would bring it to a temperature of about 0°C. This is an important improvement on the expensive and defective method of covering it with ice or laying it out in cold and relatively large stores for a period of time which must of necessity be very long. Pre-refrigeration by thorough washing in very cold water could be carried out advantageously in fishing boats. It might be of great importance in the mixed installations, proposed by M. CRIGNY for fishing boats (1) in which the use of ice plays its essential part.

The second part of the method consists in freezing the fish previously cooled to 0°C. This second stage may be attained by the use of ice, dry cold air, or, as the author proposes, soaking in cold brine.

703 - **The Supply of Canned Salmon in the United States.** — BRAND, C. J., in *U. S. Department of Agriculture, Office of the Secretary, Circular No. 98*, pp. 1-16, Washington, D. C., February 28, 1918.

Commercial stocks of canned salmon in the United States on August 31, 1917, amounted to approximately 310 000 000 pounds. Four-ninths of these stocks were located in the State of Washington.

Nearly three-fifths of the total stocks reported were held by canners of sea food. The stocks of these concerns were practically all reported from the states of Washington, Oregon and California, the canners in the first named state reporting more than three-fourths of these holdings.

One-eighth of the total commercial stocks was held in storage warehouses. As in the case of stocks of canners, those in storage were again chiefly located in the state of Washington, this state reporting two-thirds of these stocks. The wholesale stocks, which constituted more than one-sixth of the total commercial stocks, were fairly well distributed in proportion to population. The stocks of retail dealers which constituted about one-eighth of the total, appear to bear a less close relation to population, the stocks of some of the Southern States being relatively small.

The results of the survey indicate further that the stocks of canned salmon in hand on August 31, 1917, were 18.2 per cent larger than those reported for August 31, 1916. The stocks of canners of sea food showed a marked increase, this increase being only partially offset by decreases in the stocks held in storage warehouses and by wholesalers. The stocks of retailers were practically equal in amount on the two dates.

This Bulletin gives detailed information concerning the extent and the distribution of the supply of canned salmon on the date of the survey.

(1) See *Comptes rendus du 2ème Congrès français du Froid*, Toulouse, 1912, Vol. 2, pp. 506-553 (Author).

PLANT DISEASES

DISEASES DUE TO FUNGI. BACTERIA AND OTHER LOWER PLANTS.

704 - **Myxomycetes and Fungi of Ceylon.** — PETCH, T., in *Department of Agriculture, Ceylon, Annals of the Royal Botanic Gardens, Peradeniya*, Vol. VI, Pt. 3, pp. 195-256. Colombo-London, June, 1917.

The list includes 6 myxomycetes and 235 fungi collected and identified in the island during the last few years. *Oidium* spp. has also been reported on 27 different plant hosts. Notes have previously been published on some of the species enumerated.

Among the fungi are described as new to science, 46 basidiomycetes (20 hymenomycetes, 2 gasteromycetes, 24 uredinaceae), 18 ascomycetes (all belonging to the pyrenomycetes), 52 deuteromycetes (14 representatives of the ordre *Sphaeropsidales*, 7 of the order *Melanconiales*, 31 of the order *Hyphales*).

There are very numerous species of fungi either new or already noted, which were found on cultivated plants or on those useful to man in some way or other.

705 - **New Japanese Fungi** (1). — TANAKA TYOZABURO, in *Mycolo. in*, Vol. X, No. 2, pp. 86-92. Lancaster, Pa., March, 1918.

In this, the fourth paper on the subject, are given in English the descriptions originally published by various authors in Japanese, of the following species new to science.

1) *Botrytis Liliorum* Y. Fujikuro, n. sp. (published in May, 1914) : found on *Lilium longiflorum* at the Experiment Farm of Formosa (Taika-zeiho, Taihokuchô) among plants from Lûchû Island. The fungus attacks especially the leaves, on which form small spots about 1 mm. in diameter which soon cover the whole leaf, causing the total decay of the host plant; the fructifications of the fungus appear on the decayed part of the plants as a fine, powdery fur.

2) *Phyllosticta* (*Phoma*) *kawacola* K. Hara, n. sp. (May 1917) on living leaves, shoots and twigs of *Morus alba*, at Mino (Gifu-ken) and neighbouring

prefectures. The parasite causes the formation of leaf spots which gradually dry up; the leaves tear in dry weather and rot in wet weather. If the spots appear on the edges of the leaves semi-circular holes are often formed. Adjacent spots coalesce, forming irregular spots which often cover a large area of the leaf and cause the whole blade to decay. Young twigs are also attacked, turn brownish, and die, showing on the surface minute black pustules. Hard twigs when attacked have reddish spots which turn blackish after and sink considerably below the surface; they are rough and cracked. The disease causes the death of the upper part of the twig. The new Japanese name of the disease is "Kuwa no Rinmonbyô" (circle blotch of mulberry). Considerable damage is done every year.

3) *Septobasidium Acaciae* Sawada, n. sp. (November, 1911) on trunks and twigs of *Acacia Richii*. The typical locality is Taikoku-chô Shakuko (Formosa). The fungus has been observed on the euphorbia *Glochidion obovatum* on the Experimental Farm of the Agricultural Station of Formosa and on *Citrus* sp. at Taihoku-chô Kiirun; later (February, 1915), SAWADA reported this fungus in Formosa on *Prunus Persica*, *P. salicina*, *Thea sinensis*, *Salix glandulosa* var. *Warburgii* and *Melia Azedarach*. The attack of the fungus is closely related to that of certain scale insects and in many cases the dead insects are found surrounded by mycelial strands. The fungus sometimes kills *Acacia* trees; to control it a 30-50 % wood-ash solution is recommended.

4) *Cercospora Pini-densiflorae* Hori and Nambu, n. sp. (May, 1917) on the leaves of young *Pinus densiflora*, in the nursery of Makago, in the south of Kyushu Island. A great many young plants, mostly two years old, were fatally attacked. According to the reports the disease seems to be limited to the above mentioned locality, but it seems likely to prove serious unless controlled by treating seedlings with Bordeaux mixture.

5) *Helicobasidium Tanakae* Miyabe. This species, also given as *Styphnella Tanakae* Miyabe and *Septobasidium* sp. is very common in Japan on the trunks and branches of *Morus*, *Salix*, *Vitis*, *Juglans*, *Zanthoxylum*, *Prunus Mume*, *P. donarium* (= *P. paniculata*), *P. salicina*, *P. Armeniaca* var. *Ansu*, *Pyrus Malus*, *P. sinensis*, *Ribes Grossularia*, *Kerria japonica*, *Thea sinensis*, *Paulownia tomentosa*, *Firmiana platanifolia* (= *Sterculia platanifolia*) and *Pittosporum undulatum*; most Japanese authors who have described this species have confused it with *Septobasidium pedicellatum* (Schw.) but the real *Sept. pedicellatum* was first discovered by SAWADA in Formosa, where *Helic. Tanakae* does not appear to exist; *Sept. pedicellatum* appears to attack the mulberry only and also to differ in certain morphological characteristics.

6) *Nothopatella moricola* I. Miyake n. sp. (Dec., 1916) on twigs of *Morus alba*; typical locality, Iwate-Ken, Morioka-shi.

7) *Ustilina Mori* R. Hara n. sp. (May, 1917) on trunks of *Morus alba*, typical locality, Mino (Gifu-Ken prefecture), Kawakami-mura.

As regards *Valsa Paulowniae* Miyabe and Hemmi, the author points out that, besides the Japanese description recently translated by him into

English (1), two other descriptions of the fungus have been published by Dr. HEMMI, one of the discoverers of the species; all three descriptions are marked n. sp. The first article, published with the original description of the fungus (in English) appeared on July 31, 1916; it contains a full account in Japanese of the disease caused by the fungus, and compares it with other similar diseases. The third and last of these articles was published in English on September 29, 1916; it also describes *V. Paulowniae* in English. Dr. HEMMI notes that the fungus was first collected in Aomori-ken (N. Honshû), in August, 1913, by T. NAKAMURA and reported as a serious disease of the "kiri" tree. All three articles are important as they throw light on a very destructive disease of *Paulownia* in Japan, a disease analogous to chestnut blight in America, both in its swift destructive action and in the loss it causes of timber much valued for cabinet-making.

706 - **Fungi of the Philippine Islands** (2). — SACCARDO, P. A., in the *Atti dell'Accademia Veneto-Trentino-Istria*, Vol. X, pp. 57-94, Fig. Padova, 1917.

In the present fourth contribution to the mycological flora of the Philippines, the author lists 149 fungi collected and communicated as previously by Prof. C. F. BAKER.

Almost all the species enumerated come from Lucon Island and principally from the region of Los Bassos and Mount Maquiling (1098 metres high).

Four genera and 100 species, the latter belonging chiefly to the Deuteromycetes, are described as new to science.

707 - **The Resistance of Plants to Diseases and Pests, in Relation to the Acidity of the Sap.** — See No. 630 of this Review.

708 - **Patents for the Control of Diseases and Pests of Plants.** — See No. 682 of this Review.

709 - **Principal Diseases of Vegetables in Ontario, Canada.** — HOWITT, J. E. and JONES, D. H., in *Ontario Department of Agriculture, Ontario Agricultural College Bulletin* 258, pp. 48 + Figs. Toronto, Ont., 1918.

This bulletin aims at supplying growers with the information necessary for the identification of the most common bacterial and fungoid diseases. The most efficient remedies are also given.

A list is given of the diseases attacking asparagus, dwarf beans, beet, cabbages, cauliflower, carrot, celery, maize, cucumber, lettuce, melon, onion, pea, potato, pumpkin, tomato and turnip.

• 710 - **Lettuce Drop, Caused by *Sclerotinium Liberiana*, in Florida U. S. A.** — See this Review, May 1918, No. 583.

(1) See R. Oct., 1917, No. 965 (Ed.)

(2) See B., Sept. 1918, No. 276 and R., May 1918, No. 587. (Ed.)

- 711 — **Observations on the Parasitism of the Ascomycete, *Ustilina vulgaris*, in France.** — PATOUILLARD, in the *Bulletin de la Société de Pathologie végétale de France*, Vol. IV, Pt. 2, p. 100. Paris, 1917.

This fungus, well known as a saprophyte, appears to have caused the death of two lime trees in Ain, by attacking them at the base at the ground-level. The two trunks were covered for a height of 8 or 12 in. with a continuous layer of fungus, save for a width of 4 in. which remained unattacked.

The wood was completely invaded by the mycelium and had become soft up to the centre of the trees, so that a simple gust of wind sufficed to blow them down. This *Ustilina* is very common on old stumps near by, both in its aecidial and conidial forms but always as a saprophyte. In the present case it is clearly a parasite.

WEEDS AND PARASITIC FLOWERING PLANTS.

- 712 — **The Worst Weeds in Cereal Crops, in Indiana, U. S. A.** — See No. 639 of this Review.

- 713 — **The Destruction of Weeds by Sodium Bisulphate.** — *Feuille d'informations du Ministère de l'Agriculture*, Year XXIII, No. 8, p. 8. Paris, 1918.

Experiments have been undertaken in France with the object of destroying weeds among cereal crops by means of sodium bisulphate.

It was found that suitable proportions to use were: — about 80 gall. per acre of a 45 % sodium bisulphate solution (99 lb. of bisulphate dissolved in 22 gall. of water), or 360 lb. of bisulphate per acre to be treated.

Sodium bisulphate is much easier to use and requires fewer precautions than sulphuric acid, which is so often used for the same purpose.

The bisulphate is produced in large quantities by powder-works which supply farmers with 5 or 10 ton truck loads at 9 1/2 d. per 220 lb. free on rail, put up in wooden tubs provided by the buyer.

The following powder-works can supply the bisulphate: Angoulême, Bergerac, Toulouse, Saint-Chamas, Saint-Fons, Moulin-Blanc, Vonges.

INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

- 714 — **Hymenoptera Parasitic on Injurious Insects, in Southern Brazil.** — BRÈTHES, J., in the *Anales de la Sociedad Rural Argentina*, Year LIII, Vol. LII, No. I, pp. 7-11 + 2 Pls. Buenos Ayres, 1918.

Dr. A. Ronna has sent from Pelotas (Rio Grande do Sul) to the Biological Institute of the "Sociedad Rural Argentina" 6 hymenoptera parasitic on insects and representing 1 genus and 5 species new to science, which are described by the author. These hymenoptera are given below.

- 1) *Lytopilus melanocephalus* n. sp., parasitic on an undetermined lepidopterous larva injurious to lucerne (possibly *Colias lesbia*).
- 2) *Aphidius brasiliensis* n. sp., parasitic on aphids.
- 3) *Heptasmicra brasiliensis* n. sp., possibly parasitic on *Oiceticus*.
- 4) *Heteroscapus ronnai* n. gen. and n. sp., parasitic on the larva of an unidentified lepidopteron.
- 5) *Perissocentrus argentinae* Crawford var. *caridei* Brèthes (1).
- 6) *Tetrastichus isis* n. sp., possibly parasitic on *Oiceticus*.

(1) See R., October 1917, No. 981. (Ed.)

- 15 - *Dictyothrips aegyptiacus*, a Thysanopteron Injurious to the "Black Morocco" Variety of Vine, in Cyrenaica. — ZANON, V., in *L'Agricoltura coloniale*, Year XI, 2nd Half-Year, No. 6, pp. 394-397 + 2 Plates. Florence, 1917.

At Fuehat and in other vineyards in the neighbourhood of Bengasi, the author found, during 1916 and 1917, that *Dictyothrips aegyptiacus* (Marhal) Del Guercio was present almost exclusively on the "Black Morocco" variety of vine ("ribier" in French, "uva damascena" in Italian) somewhat suffering from drought and grown on a trellis and kept low.

This tiny thysanopteron not only soils the foliage with its excreta which appear as scattered groups of small black points, but also pierces the leaf blade, causing the formation of discoloured areas of varying size, and eventually the drying-up of the leaves themselves.

The morphological description of the various stages of development of the insect is followed by notes on its biology.

- 16 - *Lonchaea aristella*, a Dipteron Injurious to the Fig Tree and the Wild Fig Tree in Italy. 1. — I. SAVASTANO, L., in *Annali della R. Stazione di Agricoltura e Frutticoltura, Agrcole*, Vol. IV, pp. 113-146 + 2 Pl. Agrcole, 1917. — II. SILVESTRI, F., in *Boletino del Laboratorio di Zoologia generale e agraria della R. Scuola superiore d'Agricoltura in Portici*, Vol. XII, pp. 123-146 + 19 Figs. Portici, 1917.

SAVASTANO, who was the first (in 1915) to report the presence of *Lonchaea aristella* Beck ("mosca nera del fico", black fig fly) in Italy, has continued his studies on this dipteron, injurious to the fig tree in the Sorrento peninsula, and especially in Vico Equense.

SILVESTRI made observations in the neighbourhood of Portici, near Naples, and in Cilento, and examined specimens of the insect from various Italian localities and other districts bordering on the Mediterranean (province of Porto Maurizio, Perugia, Caserta, Benevento, Bari, Lecce, Cosenza, Catania, Trapani, Palermo, Sassari, and Portugal, Spain, Corfu, Tripoli, Algeria). He recognised that the fly is a parasite which does much damage to the wild and the ordinary fig trees.

Both authors give much information on the biology and habits of the insect of which SILVESTRI gives a detailed morphological description.

The only varieties of fig tree attacked are those the fruit of which have large scales arranged almost horizontally, not short and converging towards the interior of the eye. Among the cultivated varieties those attacked are, in the province of Naples, "troiano" and "natalino"; in Cilento, "pas-carolo" and "fico a tre produzioni"; in Sicily, "biancoillo" and other white and black varieties.

Of the wild fig-trees, which, according to SILVESTRI is the fly's favourite plant host, the varieties with an elongated, oval receptacle, well-developed cavity and horizontal scales, are the best suited to the development of the insect.

The enemies of the insect mentioned by SAVASTANO include ants, the coleopteron *Sinoxylon sexdentatum* Oliv., the beafico and the finch. From pupae of *Lonchaea*, collected at Portici and Resina, SILVESTRI ob-

(1) See B. July, 1915, No. 777. (Ed.)

tained specimens of a chalcid hymenopteron, *Pachyneuron vindemmiae* (Rond.), which however, is of little or no importance in controlling the insect.

As regards artificial means of control, besides collecting and destroying the ripe and unripe receptacles which have fallen, the cultivation of the varieties most attacked should be given up, or at least limited. The wild fig, unless absolutely necessary to ripen the receptacles of varieties of real economic importance, should not be cultivated. Where caprification is necessary only those varieties of wild fig should be used the receptacle of which has short scales converging towards the interior of the eye.

According to SAVASTANO, too great cultural care should be avoided, especially excessive fertilising with farm-yard manure, because this causes a greater separation of the scales, thus facilitating attack by the insect.

The practice of "touching", adopted in the province of Naples, by which a drop of olive oil is placed in the eye in August to hasten ripening, is an indirect means of defence against the fly; the eye contracts, the scales do not open, and the oil penetrates the interstices, so that the insect cannot deposit its eggs in the fruit.

717 - *Corythucha spinulosa* Gibson, a New Lace-bug on Wild Cherry in New Jersey.

— DICKERSON E. L. and WEISS, H. B., in *Entomological News*, Vol. XXIX, No. 1, pp. 121-125 + 1 Plate, Philadelphia, April, 1918.

This paper gives a morphological and biological description of *Corythucha spinulosa* Gibson, first observed towards the end of the summer of 1916 feeding on leaves of wild cherry (*Prunus serotina*) at Jamesburg, New Jersey. So far this species has only been found in that locality.

718 - Insects Injurious to Forest Trees in Sweden in 1916. — TRAGARDE, IVAR, in *Skogen*, Year V, Pt. 1, pp. 10-20 + 5 Figs.; Pt. 2, pp. 45-62 + 8 Figs. Stockholm, 1916.

The paper contains a list of the insects injurious to forest trees reported in Sweden in 1916, together with notes on their distribution throughout the kingdom, especially from the point of view of local climatic conditions.

Ips typographus L. ("Granbark borren") and *Pityogenes chalcographus* L. ("Sextandade Barkborren"). The province of Härnösand was the chief centre of attack; here the insects were reported from nearly all the forests (70 %). Then came, Mellersta Norrland, Gävle, Dala, and Östra, with 50 %. No damage, however, was reported from Övre Norrbotten or the province of Skellefteå, but in Nedre Norrbotten, Umeå, and the province of Bergslagen, 25 to 28.5 % of the forests were attacked. In the southern districts of Västra, Småland and Södra, the figures vary between 10 and 22 %.

The temperature has a great influence on the development, and, consequently, also on the multiplication and diffusion of *Ips typographus*. According to the observations of KOLMODIN and HENNING, in the Orsa forests in 1914, the life cycle of the first generation covers a period of 70 days (May 16 to July 24), whereas in Germany (Tharandt) it lasts 52 days (May 30 to July 21). This difference is accounted for by the temperature. At Tharandt, according to UHLIG, the total temperatures for the 52 days was

45°C. with an average of +22.02°; at Falun (the nearest observatory, Orsa) the total for the 70 days was 1151°C., with an average of +16.4°.

Bupalus piniarius L. ("Tallmätaren"). — The districts which suffered most in 1916 were Nyköping (Sörby), Jönköping, Västbo (Nennesmo), Tjust, Södra Møre, and all the Kalmar district. In studying the distribution of the insect from 1889-1916, it is seen that the chief centres of attack are found in the east of Sweden, to the east and north of the 550 mm. isotherm. The atmospheric precipitation decreases as one passes from the Atlantic to the Baltic districts, and, as the rainfall decreases the possibility of development of *Bupalus* increases. The attacks of this insect are most frequent and widespread in those districts and years in which the total rainfall below 550 mm.; this is seen from the following table.

	Average precipitation in mm.	Precipitation at the time of an attack in mm.	Decrease — %
Orebro	577.4	458.8	20.5
Nyköping	563.3	499.8	27.2
Gävle	487.5	377.7	22.4
Kalmar	431.1	368.7	15.4

Lophyrus sertifer Geoff. and *L. pini* L. ("Tallsteklarna"). — In 1916, these insects were observed in a few districts only — Storlandet, Luleå, Härpenberg, Halmstad, Tjust, and Lunnerbo. An examination of the chart of the distribution of *Lophyrus* in Sweden during the period 1880-1915 confirms the general diffusion of the insects from the south to the far north and, at the same time, shows clearly the influence of temperature in their development. The chief centres of attack are to the south of the isotherm + 5°C.

The following were also reported:— *Myelophilus piniperda* and *M. minor* ("Märgborrarna"); *Ips sexdentatus* Boern. ("Tolvtandade Barkborren"), *I. acuminatus* Cyll. ("Skarptandade Barkborren"); *Hylobius betis* L. ("Snytboggen"); *Melasma acnea* L. ("Algullbaggen"); *Agrostica alni* L. ("Blå Allövbaggen"); *Liparis monacha* L. ("Nunnan"); *Eriogaster lanestris* L. ("Björkspinnaren"); *Panolis griseovariegata* Goeze ("Tallflyet"); *Hibernia acfoliaria* Cl. ("Lindmätaren"); *Tortrix resinella* L. ("Martsgallvecklaren"); *Argyresthia illuminatella* Zell. ("Granknoppsvecklaren") and *Lyda hieroglyphica* Christ. ("Tallkultur-Sackepinnaretekeln").

[118]

